THE HEATING AND VENTILATING MAGAZINE

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NEW YORK, JULY, 1911

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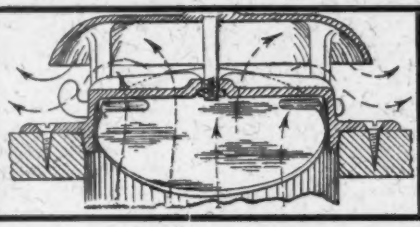

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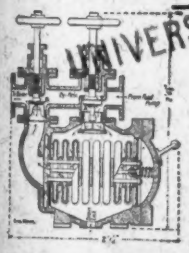

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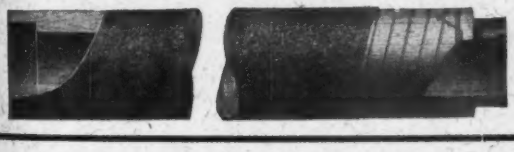

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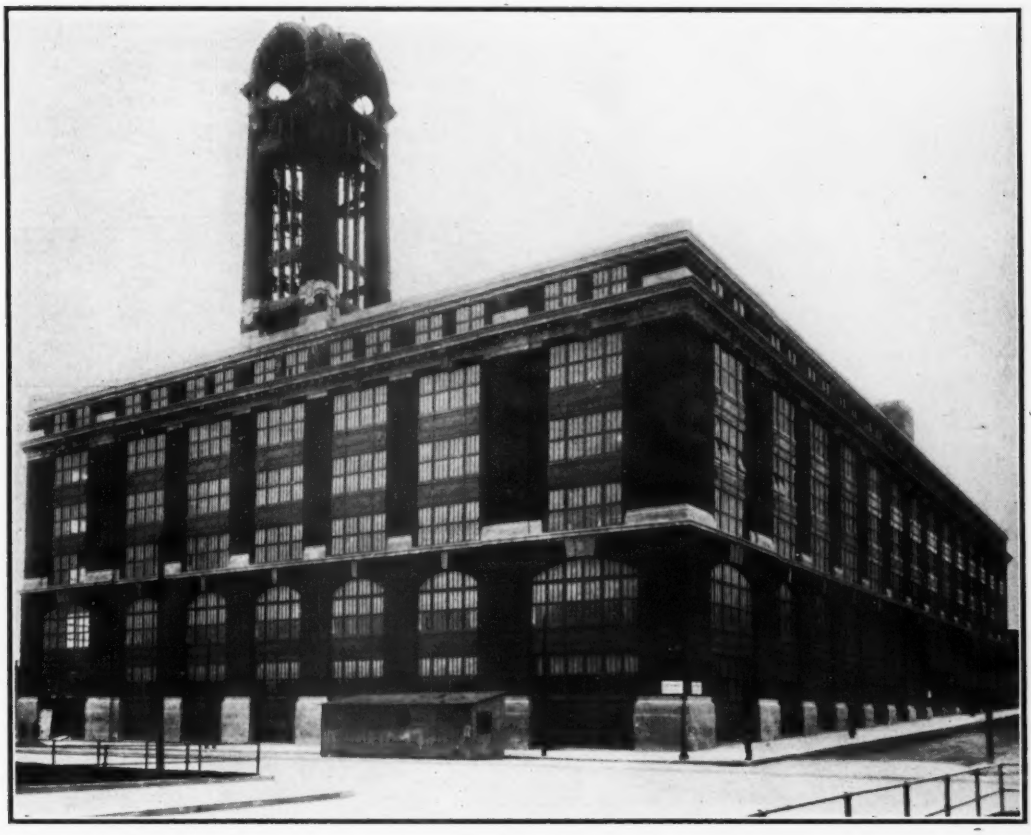
THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JULY, 1911

Mechanical Equipment of a Modern Factory Building

HEATING, VENTILATING AND AIR WASHING SYSTEM IN PLANT OF BREWSTER & CO., LONG ISLAND CITY, NEW YORK

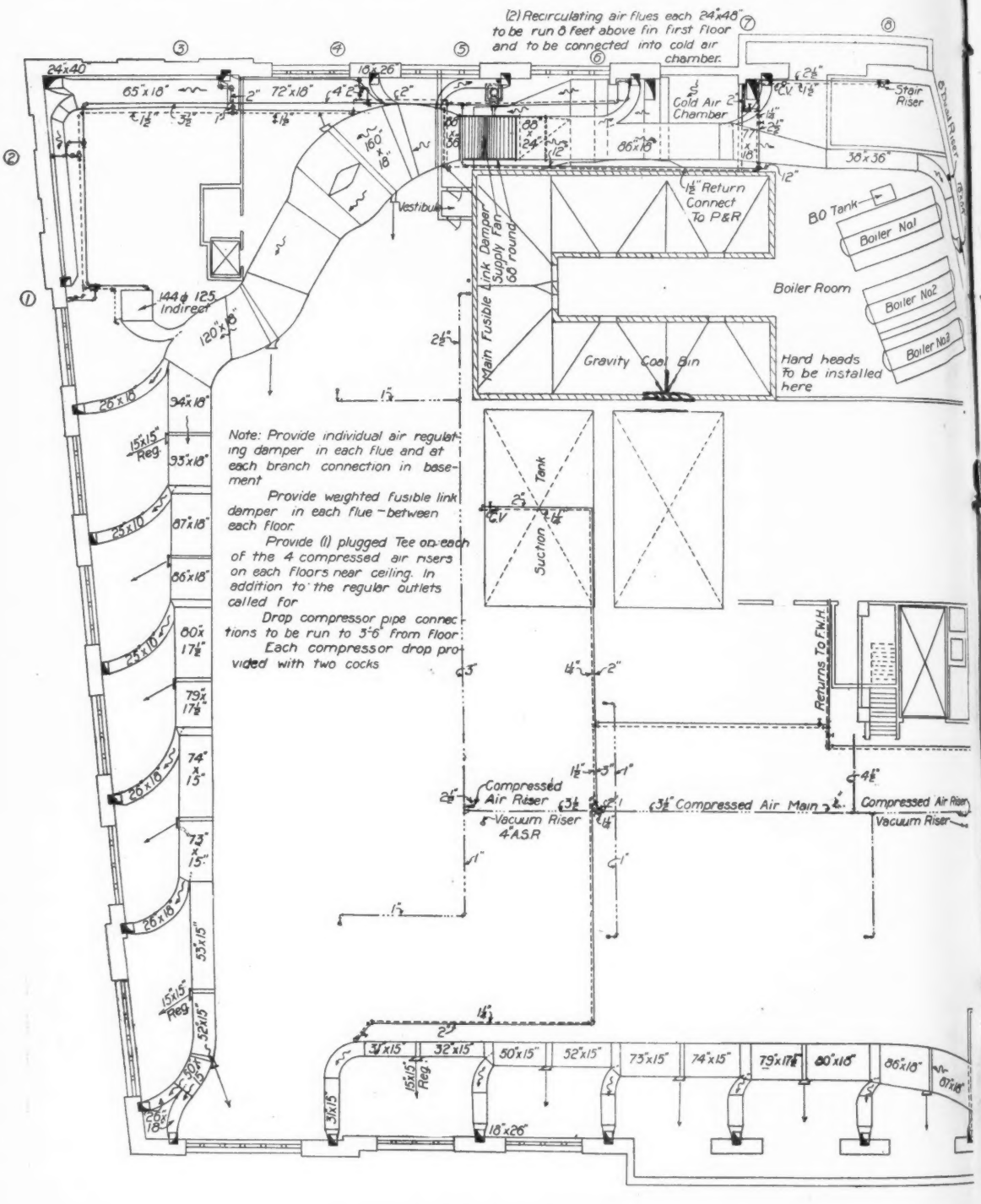
As a rule, we think of a factory as a building designed solely to fill the requirements of the industry, severely plain in its appearance and, perchance, displeasing to our æsthetic taste. But in the factory of Brewster & Company, Long Island City, N. Y., the architects, Stephenson &



FACTORY OF BREWSTER & CO., LONG ISLAND CITY, N. Y.

Wheeler, of New York, have shown that architectural beauty does not always have to be sacrificed in the design of a manufacturing plant.

This building, located on Bridge Plaza, between Prospect and Radde streets, is a six-story structure surmounted by an imposing tower. Its appearance is suggestive of a convention hall. That the comfort of the occupants has been given much consideration is shown by the fact

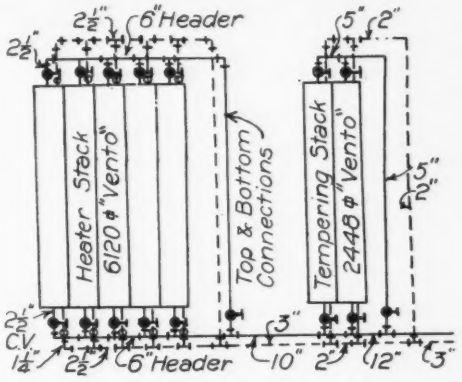

(2) Recirculating air flues each 24"x48" to be run 6 feet above fin first Floor and to be connected into cold air chamber.
Cold Air Chamber
Stair Riser
Vestibule
1½" Return Connect To P&R
B.O Tank
Boiler No1
Boiler No2
Boiler No3
Boiler Room
Main Fusible Link Damper Supply Fan 66 round
Gravity Coal Bin
Hard heads To be installed here
144 ø 125 Indirect
Note: Provide individual air regulating damper in each flue and at each branch connection in basement
Provide weighted fusible link damper in each flue – between each floor
Provide (1) plugged Tee on each of the 4 compressed air risers on each floors near ceiling. In addition to the regular outlets called for
Drop compressor pipe connections to be run to 5'-6" from floor
Each compressor drop provided with two cocks
Tank
Suction
Returns To F.W.H.
Compressed Air Riser
Vacuum Riser 4" A.S.R
3½" Compressed Air Main
Compressed Air Riser
Vacuum Riser
15"x15" Reg.
3'x15"
32"x15"
50"x15"
52"x15"
73"x15"
74"x15"
79"x17½"
80"x18"
86"x18"
87"x18"
18"x26"

BASEMENT HEATING PLAN. PLANT O

that the heating and ventilating system consists in every respect of the latest type of apparatus, including arrangements for cleansing and humidifying of the air which is performed by air washers made by Warren Webster & Co.

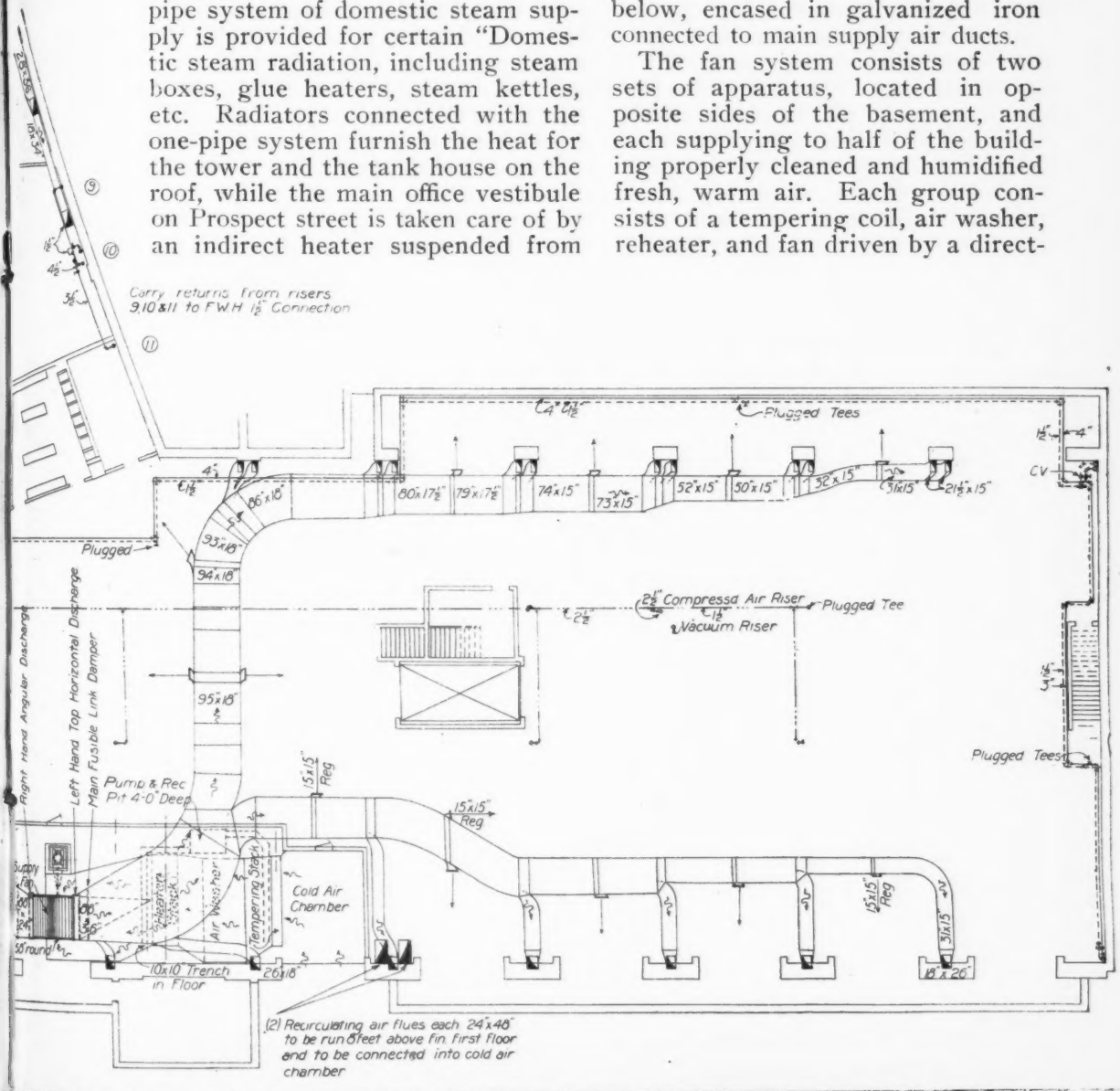
THREE SYSTEMS OF HEATING AND VENTILATING

The heating and ventilating plant consists of three systems. Practically the entire building is heated by the fan system. However, in certain rooms on the second and sixth floors, supplemental direct radiation from a one-pipe system is used. A two-pipe system of domestic steam supply is provided for certain "Domestic steam radiation, including steam boxes, glue heaters, steam kettles, etc. Radiators connected with the one-pipe system furnish the heat for the tower and the tank house on the roof, while the main office vestibule on Prospect street is taken care of by an indirect heater suspended from the basement ceiling immediately below, encased in galvanized iron connected to main supply air ducts.



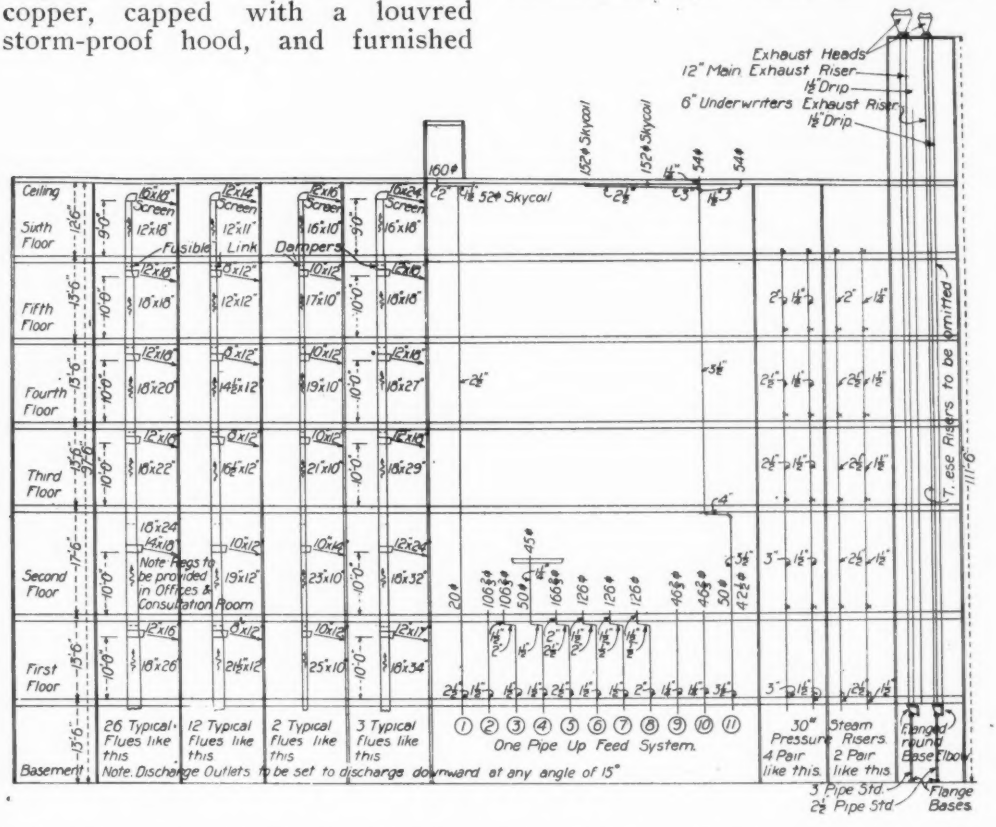
DIAGRAMMATIC SKETCH OF MAIN PIPING TO TYPICAL HEATER AND TEMPERING STACKS.

The fan system consists of two sets of apparatus, located in opposite sides of the basement, and each supplying to half of the building properly cleaned and humidified fresh, warm air. Each group consists of a tempering coil, air washer, reheater, and fan driven by a direct-


Carry returns from risers 9,10 & 11 to F.W.H. 1½" Connection
Plugged Tees
Plugged
2½" Compressd Air Riser
Plugged Tee
1½" Vacuum Riser
Plugged Tees
Right Hand Angular Discharge
Left Hand Top Horizontal Discharge
Main Fusible Link Damper
Pump & Rec Pit 4'-0" Deep
Cold Air Chamber
Air Washer
Tempering Stack
10x10 Trench in Floor
(2) Recirculating air flues each 24"x48" to be run 8 feet above fin. first floor and to be connected into cold air chamber

connected vertical steam engine. Inasmuch as the only difference in these sets is that one fan is a right-hand top horizontal and left-hand bottom discharge, while the other is the reverse, the same description applies to both.

On both Prospect and Radde street sides of the building are located the fresh air intakes for the respective fans. They are made of copper, capped with a louvred storm-proof hood, and furnished braced with 2 x 2 x 3/16-in. angles. The spray device extends the full width of the spray chamber and is made up of a brass water pipe, with 7/32-in. perforations on both sides, over which runs a curved copper hood. The water jets from the spray pipe impinge on the inside surface of the hood in such a manner that a double sheet of water is formed through which all the air



COMBINED HEATING AND VENTILATING RISER DIAGRAM. PLANT OF BREWSTER & CO.

with fine mesh copper screens and dampers. After leaving the cold air chamber the air passes over the tempering stacks, consisting of 2,448 sq. ft. of American Radiator Company's Vento radiating surface and enters the air washer. From this point it is drawn through the reheater of 6,120 sq. ft. of Vento radiating surface and distributed by the fan to the two main ducts, from whence it is delivered to the various floors.

The capacity of each of the air washers is 85,000 cu. ft. per minute. They are built of galvanized steel, must pass before being delivered to the building. The spray water falls into a tank below and is re-circulated by means of a Tacony Iron Co.'s brass-fitted turbine pump direct-connected to a Crocker-Wheeler motor. On leaving the air washer the air is drawn over the reheater and then is forced to the various floors.

The fans have 68-in. inlets, the discharge being horizontal at the top and annular at the bottom. The 12-in. x 10-in. vertical enclosed self-oiling steam engine is capable of driving them at 250 R.P.M.

In connection with the tempering and reheating stacks, there is installed a Powers system of temperature control. This is accomplished by a cold air thermostat operative at 38° to 40° F. in such a manner as to guard the air-washers at all times against freezing.

When the temperature of the entering air drops below 38° F. the tempering coils are supplied with steam, the thermostat being connected to the supply and return valve of the individual groups of the tempering coils. In connection with this system there is an automatic electric air compressor with suitable storage tank, automatic governor, indicating gauge, etc.

The tempering stack consists of two groups of 60-in. Vento cast-iron radiators, each group being 36 sections wide and 3 sections high. The reheating stack is similar to this, with the exception that it is 5 groups deep instead of two.

Steam is supplied to the systems by three Heine (150 H.P. each) water-tube, longitudinal drnm type boilers located in the basement, and the working pressure carried is 150 lbs. In this connection it might be stated that these boilers were installed under extreme limited headroom conditions, 12 ft. 5 in. only being available in the clear. It was, therefore, necessary to resort to making the nozzle connections out of the front drums. For the domestic steam system a reducing valve allows the use of 30 lbs. steam. The exhaust from the fan engine is used in the heating system, supplemented by live steam where necessary. The water of condensation from all the hot blast heating stacks is removed by an automatic pump.

The flues of the fan system discharge in general about 10 ft. above the floor of the room and downward at an angle of about 15°. Screens of the plain lattice or diamond design mesh are provided. Above the register faces are placed adjustable regulating dampers.

PROVISION FOR RECIRCULATING AIR

A recirculating flue connection is made to each intake chamber so that, during the closed down period of the factory, the building is heated by recirculated air. Another advantage of this arrangement permits of the rapid heating of the building during the early morning hours by a 1apid circulation of the recirculated air.

The entire steam power plant, heating, ventilating and forge supply exhaust plants, were designed and supervised by Messrs. Griggs & Holbrook, of New York, consulting engineers for the Brewster Company, and were installed by the Fentzlaff Heating and Plumbing Company, also of New York.

A Plan to Advance Foreign Trade

American manufacturers and producers are invited to file with each American consulate a statement respecting the lines of goods they have to offer to foreign buyers.

Heretofore American manufacturers have had the privilege of filing catalogues in the consulates, but the diversity of size and form of catalogues and other printed matter thus far filed, and the filing of this printed matter in English in consulates requiring other languages, has entailed unnecessary time and expense in clerical force, correspondence and translation work in the consulates. It is now proposed to obviate these disadvantages by asking each manufacturer to prepare a brief of his catalogue or printed matter according to card index specifications, these cards to be classified in card index files under proper headings, and to print same in the various commercial languages.

This coöperative plan has been arranged between the Department of State and the Commercial Bureau Company for placing with each American consulate an encyclopedia of the industries of the United States. The work, we understand, is done without charge to the manufacturer. Full particulars will be given by The Commercial Bureau Company, 50 Church St., New York.

A Movement to Standardize Catalogues

A committee of the American Society of Mechanical Engineers has been appointed to take up the subject of the standardization of catalogues. The members of the committee are Prof. William Kent, W. B. Snow, M. L. Cooke and J. B. Bibbins.

Coefficients of Heat Transmission*

By John R. Allen,

PROFESSOR MECHANICAL ENGINEERING, UNIVERSITY OF MICHIGAN.

Transmission of heat from surfaces, both conducting and non-conducting, is of great interest to every engineer connected with heating work. There have been many experiments made along these lines, but there is still a vast field that is untouched and many simple facts we do not know.

We may divide these surfaces into two general classes; those in which the heat passes from the surface by the natural circulation of the air along the surface produced by the heated surface itself, and those in which the air passes by the surface due to a forced circulation, as in a fan system. In the first class a large portion of the heat is given off by radiation and in the second it is almost all given off by convection. Consider first those surfaces along which the air circulates by natural draft.

Engineers have generally agreed in this case that the transmission of heat depends upon the difference in temperature between the air in the room and the steam in the radiator multiplied by a certain constant depending upon the form and the condition of surface. At the University of Michigan, we have for about twenty years been conducting experiments upon the transmission of heat through surfaces and we find that, under similar conditions, the coefficient of transmission for the same radiators remains constant. The constants are determined in the following manner: The condensation of the steam in the radiator is carefully determined per square foot of surface, and this multiplied by the latent heat of the steam at the given pressure gives the heat loss per square foot of surface, Dividing this loss by the difference in the temperature between the steam in the radiator and the temperature of the air in the room gives the coefficient of heat transmission. The foregoing table gives the coefficient of heat transmission for various radiators.

TABLE I

HEAT TRANSMISSION FROM DIRECT RADIATORS

Type of Radiator Cast Iron	No. of Square Feet	No. of Lbs. Condensed per Hr. per Sq. Ft.	Coefficient of Transmission
1 column	48	.212	1.82
2 column	48	.265	1.65
3 column	45.3	.204	1.45
6 column	36	.217	1.35
WROUGHT IRON			
1 column	12	.446	3.27
2 column	42	.286	2.
3 column	48	.294	1.77
4 column	48	.202	1.27
1-IN. PIPE COIL			
1 pipe high	....	.41	2.8
4 pipes high	....	.425	2.48
WALL COIL	Sq. Ft. per Sec.		
Section vertical	5	....	1.92
Section horizontal	5	....	2.11
Section vertical	7	....	1.70
Section horizontal	7	....	1.92
Section vertical	9	....	1.77
Section horizontal	9	....	1.98

Height of cast-iron and wrought-iron radiator is 38 in.

In order to determine how nearly constant this coefficient remains, a series of experiments were made at varying room and steam temperatures. The following table gives the results of this experiments. You will notice that for ordinary conditions of opera-

*Read at the third annuel convention of the National District Heating Association, June 6-8, 1911.

tion this coefficient remains fairly constant, so that it is hardly necessary to take the variation into consideration, except in very accurate work, and then only where the range of temperature is very great does the variation in this coefficient materially affect the heat loss from the radiator.

TABLE II

HEAT TRANSMISSION THROUGH CAST-IRON RADIATOR UNDER VARYING CONDITIONS OF TEMPERATURE

Difference in Temperature	Coefficient of Transmission
80	1.56
100	1.58
120	1.615
140	1.645
150	1.65
160	1.675
170	1.69
180	1.705
190	1.72

The transmission of heat through radiators and also the coefficient of transmission will be affected by the temperature of the surfaces to which the radiator radiates its heat. In the first experiments that were made at the University of Michigan, the room used had very little outside wall or window surface.

Some fifteen years later this apparatus was moved into another room containing a large amount of window surface. The effect of this change was very marked. The coefficient of transmission was raised about 7%. This accounts for the fact, which is well known, that in greenhouse heating the rules are entirely different from those used for an ordinary house. Where radiators are exposed so that the direct rays of heat from the radiator strike directly on cold glass surfaces at a low temperature the radiation loss is measurably increased. This is of great assistance to the engineer for, if he figures his radiation too low in a room with large glass surfaces, he is helped by the fact that the radiator gives off more heat and tends to make up for the lack of surface.

The coefficients given in the previous tables are given for rooms having an average amount of glass surface.

The transmission of heat through radiators is also affected, to a small degree, by humidity. The effect of humidity is shown in the following table:

TABLE III

EFFECT OF HUMIDITY ON THE TRANSMISSION OF HEAT THROUGH CAST-IRON RADIATOR

Percentage of Moisture Saturation	Coefficient of Transmission
20	1.79
30	1.77
40	1.73
50	1.72
60	1.69
70	1.66
80	1.63
90	1.61
100	1.59

You will notice that as the humidity in the air increases the heat losses from the radiator diminish. This is contrary to what might be expected, but the reason for it is quite evident when carefully considered. Water vapor occupies twice the volume of air under the same pressure so that when the air in the room is moistened we have less weight of the medium passing the radiator than when the air is dry, and therefore less heat lost by convection, which lowers the total heat transmission. The effect of the moisture in the air through the most extreme ranges of humidity only changes the coefficient of transmission about 5%.

TESTS OF INDIRECT RADIATORS

In indirect radiators, where the air passes over the surface at a high velocity, and this velocity is subject to a wide range depending upon the conditions of operation, it is necessary, in determining the coefficient of transmission, to take into consideration the velocity of the air passing over the surface, as well as the difference in temperature between the temperature of the air outside and the steam inside the radiator. The results deter-

mined from experiments go to show that this coefficient is almost constant and may be determined in the following manner:

Divide the B. T. U. transmitted per hour by the difference between the average temperature of the air passing the radiator and the steam in the radiator. Divide this quotient by the number of cubic feet of air passing per square foot surface per hour. The final quotient will be the coefficient. The following table gives this coefficient for an indirect pin radiator of standard form and for a long pin indirect radiator. The irregular variations in the coefficient are undoubtedly due to the errors in observation. You will notice that the coefficient increases as the velocity of the air passing the radiator is increased.

TABLE IV

COEFFICIENT OF TRANSMISSION FOR INDIRECT PIN RADIATION

Cu. Ft. of Air per Hr. per Sq. Ft. Surface	B.T.U. per Hr. per Sq. Ft. Actual Surface per Deg. Diff. over Air and Steam		Coefficient	
	Short Pin	Long Pin	Short Pin	Long Pin
50	.8	1.0	1.6	2.0
100	1.52	1.55	1.52	1.55
150	2.25	2.20	1.49	1.5
200	2.85	2.75	1.43	1.45
250	3.55	3.25	1.42	1.30
300	4.25	3.7	1.415	1.23
350	4.85	4.2	1.385	1.20

Similar coefficients of transmission may be obtained for fan coil radiation. This is determined in exactly the same way as above with the exception that the final divisor is the velocity of air passing the radiator in lineal feet per minute. The following table gives the coefficient of heat transmission for 1-in. pipe fan coils. It will be noticed from this table that the coefficient varies with the depth of the fan coil surface. For any given number of sections the coefficient remains approximately constant.

The object of obtaining these coefficients is to enable the engineer to compute approximately the heat losses in the given forms of surfaces under all conditions. We have these heat losses pretty well determined by experiment for ordinary conditions of operation, but the engineer frequently meets with conditions of operation which are exceptional, and by means of this coefficient he will be able to determine the heat losses, at least approximately, under these exceptional conditions.

The laws governing the heat transmission through various surfaces are really not well determined. Much experimental work must be done along these lines in order to enable the engineer to make his computations more exactly. The most successful rules for de-

TABLE V

COEFFICIENT OF TRANSMISSION FOR FANHEATER COILS (OUSTIDE TEMP. 0° F.)

No. of Section	Velocity Through Heater In Feet Per Minute									
	800		1000		1200		1400		1600	
	Vento	Pipe Coil	Vento	Pipe Coil	Vento	Pipe Coil	Vento	Pipe Coil	Vento	Pipe Coil
1	.120	.....	.120	.....	.120	.....	.120	.....	.120	.....
2	.0595	.0535	.0592	.0575	.059	.058	.0585	.058	.058	.0575
3	.0398	.0350	.0399	.0379	.040	.040	.041	.041	.042	.040
4	.0301	.0240	.030	.0269	.030	.030	.038	.030	.039	.030
5	.240	.0160	.0240	.0203	.0240	.028	.0240	.030	.0239	.029
6	.0198	.0140	.0199	.0165	.0199	.019	.0199	.019	.0198	.019
7	.0172	.011	.0171	.0145	.0170	.017	.0171	.017	.0171	.0165
8	.0149	.099	.0151	.0125	.0150	.0155	.150	.016	.0150	.0155

termining heat losses in transmission through building are those developed by the German engineers and given in a small pamphlet published by J. H. Kinealy, who has translated the German work into English. This is entitled "Formulas and Tables for Heating." These German engineers have given coefficients for conditions sometimes met with by engineers which are not familiar to a great many Americans. The following coefficients might be added to the list of those already given.

	Coefficient.
From air to smoke through a clay plate ⅜ in. thick to air	1
From air to smoke through cast-iron or sheet-iron plate to air	1.4—2
From air to smoke through cast-iron or wrought-iron plate to air on outside	2.6—4
From steam through cast-iron or wrought-iron plate to air	2.2—2.6
From steam through metal wall to water	160—200

The coefficients given in the above table assume that the medium on the two sides of the plate through which the air is heated is circulated by natural circulation. These conditions are very much modified if the medium on the two sides of the plate is given a more rapid circulation. The following table shows the variation coefficient of heat transmission due to the velocity of the water passing along the walls of condenser tubes:

TABLE VI

HEAT TRANSMISSION FROM STEAM TO WATER IN CONDENSER TUBES (FROM DATA)

Velocity of Water, Feet per Minute	Coefficient of Transmission
40	220
60	350
80	450
100	520
120	600
140	680
160	750
180	800
200	850
220	900
240	940

All experiments thus far show that in general the coefficient increases with the increased velocity of the medium on the two sides of the plate. The laws governing the effect of such velocities are not known. At the present time the University of Michigan is carrying on an elaborate series of experiments with fan heaters, and with the heating by hot water, with the hope that some more definite information may be obtained with reference to the effect of the velocity upon the heat transmission through metal surfaces. One reason why more work has not been done along these lines is the fact that such experiments require elaborate and expensive apparatus and years of time.

Vapor Heating Systems

By Thomas G. Mouat

Some interesting observations on the principle and operation of vapor heating systems are contained in a discussion of the subject by Thomas G. Mouat before the Ohio Society of Mechanical, Electrical and Steam Engineers. Among other things Mr. Mouat said:

About twenty-six years ago, while working as an apprentice at the steam-heating trade, I heard a journeyman steam-fitter remark that vapor was the coming heat. I asked him what he meant by the term "vapor," and he said it was steam slightly above atmospheric pressure. In those days and for many years following it was deemed necessary to carry from 1 to 10 lbs. of steam pressure to heat a building successfully with the ordinary gravity low-pressure system without the

means of producing a partial vacuum; and most boiler manufacturers still set the pop valves to blow at 15 lbs.

But this steam fitter's prophecy has been realized, and though it is a far cry from 10 lbs. pressure to 2 oz. pressure, it has been practically demonstrated that a building can be heated in the coldest weather with from 2 to 3 oz. pressure, and the term "vapor heat" is now applied to a steam-heating system which operates under this very low pressure.

The main object of vapor heating is to provide for a system that will operate with just a little heat turned on each radiator, enough heat to be comfortable without over-heating in moderate weather and plenty of heat for the coldest days, by simply opening the supply valves a little further. Each room may be heated regardless of the rest of the building, to suit the requirements of the occupant or the purpose for which it is used.

Several attempts were made from time to time to perfect a system, which would permit the partial heating of the radiators, but in each case they met with failure due to the inability to control the pressure with the ordinary diaphragm damper regulator and devices of this character, where the steam pressure was directly applied to do the work.

I remember years ago reading of an English heating engineer who invented a system which could be graduated to some extent. He advocated locating the boiler in a pit about 4 ft. deeper than the ordinary basement floor, so that the water could not back up in returns high enough to cause any trouble when the pressure got too high. This system was not practical. A boiler put so deep is dangerous to the occupants of the house, and difficult to take care of; it may be too low for the ordinary sewer connections, so that the pit could not be drained; and the pressure variation provided for and sure to occur was too great to guarantee any practical result along the lines of graduation.

It was not until the direct application of steam in connection with a diaphragm was dropped, and the energy of water plus the steam pressure was employed for the purpose of regulating the boiler pressure, that a system permitting positive and practical graduation was perfected.

The graduated admission of steam to each radiator may now be accomplished in a properly constructed vapor system by the use of a sensitive pressure and damper regulator attached to the boiler, fractional valves and special return fittings on the radiators, and an opening in the return pipe near the boiler to permit the escape of air. No air vents are used on the radiators.

The regulator must be so constructed that it will open or close with the variation of 1 oz. of pressure. This result has been obtained by a regulator operated according to the principles of a hydraulic balance, water being forced out of a stationary tank into a movable tank placed at the end of a lever which causes the movable tank to tilt downward and close the dampers. When the pressure has dropped an ounce, part of the water leaves the movable tank and returns to the stationary tank; the movable tank is then tilted upwards by the aid of a counter-weight and the reverse operation of lever and dampers occur. This regulator is positive in operation; when the pressure decreases there is nothing to hold it shut, and with an increase of pressure it must close, as the power exerted by the pressure plus the weight of water is greatly in excess of the force required to operate the regulator.

There is also a regulator on the market operated by a float in a tank placed alongside of the boiler. When the water is forced out of the boiler the float is raised and the drafts closed. When the water in the tank drops back into the boiler again the

float descends and the dampers are opened.

The graduating valves are constructed so as to permit a small amount of steam to enter the radiator, so little that it will be condensed in heating a small portion of it, or they may be opened still farther and so heat the entire radiator. The valves are furnished with stop screws so that they may be set to heat the entire radiator without permitting any steam to pass through the radiator into the return pipe.

The valves are generally placed at the top connection of the radiator. Water radiators are used, which heat horizontally along the top first and thence downward according to the amount of steam turned on. The return fitting is placed at the opposite end and connected to the bottom connection of the radiator. This return fitting is constructed with a small water seal which presents a full opening for the flow of condensation into the return pipe, and a restricted opening for the escape of air into the same pipe. This restricted opening and water seal retard the flow of steam into the return pipe. The air and water travel together to a point near the boiler, where an opening for the escape of the air is provided in the top of the return pipe. From this a pipe leads to the chimney flue, where a slight reduction in pressure is caused tending to help the removal of the air. The water separated from the air falls to the boiler.

A low pressure is absolutely necessary in order to permit circulation under graduation, and a practically constant pressure is required to perfect the graduation.

The ordinary steam-heating system with its variable pressure, uncertain regulation, and tendency toward vacuum will not permit of any graduation. A sufficient reduction of pressure in the radiator due to the partial closing of the supply valve would immediately fill the radiator with water through the return pipe; or in a one-pipe system the radiator would gradually fill with water if the supply-valve area was materially curtailed.

No vacuum can be produced in a vapor-heating system of this type because, as has been already stated, it is open to the atmosphere. With the ordinary steam-heating system the supply valves must be either turned on full or shut off tight, which frequently makes the rooms either too hot or too cold, causing waste of fuel and discomfort.

With the vapor-heating system the pressure is generally much higher in the supply pipes than in the radiators. It may be 2 oz. in the pipes and only a small fraction of an ounce in the radiators, due to graduation and condensation. The water of condensation returns to the boiler at a very low temperature, averaging about 85° F., and with some vapor systems the return water may be reheated by means of the waste gases, and, owing to its own low temperature, it is capable of absorbing a large amount of heat which would be otherwise wasted in the ordinary steam system on account of the much higher temperature of the return water.

There are a good many other reasons which recommend the vapor system to the public and I will mention a few of them: the very low pressure at which the system operates reduces the cost of maintenance to the minimum. It is noiseless in operation, as there is not enough pressure to produce noise. It is economical in operation, due to the sensitive regulation, the very low pressure and the graduation. It is capable of keeping up steady heat from 10 to 12 hrs. with hard coal without attention, always insuring a warm house in the morning. There are no air vents to leak, sputter, or emit odors into the rooms. It is much quicker to act than hot-water heat. The danger from leakage or freezing is reduced to the minimum.

The radiators are smaller than used for hot water, and about 15% larger than for the ordinary steam systems.

When natural gas is used for fuel, the regulator is attached to a butterfly valve on the gas supply pipe, which prevents over-pressure and makes the system almost automatic, with the ex-

ception of turning the valves on and off at the radiators.

The safety valves are set to blow at 8-oz. pressure. I have been heating my own home during the last two months with about ¾-oz. pressure at the boiler.

Altogether the vapor-heating system is a very satisfactory means of modern heating, and I recommend it to your further investigation.

In reply to questions Mr. Mouat stated that a hot-water system could be changed to a vapor system by providing a steam space in the boiler. The low steam pressure of ¾ oz. was measured by a water-column, and not by an ordinary spring steam gauge. He considered the vapor system safer than a water system on account of the water-seal and automatic water supply.

The Official Federal Furnace League Method of Testing Furnaces*

By Dr. W. F. Colbert,

ENGINEER OF THE FEDERAL FURNACE LEAGUE

At the last annual meeting of the Federal Furnace League it was decided that a standard method of estimating furnace heating requirements and a standard method of installing furnaces should be adopted.

It was also decided that furnaces should be rated in accordance with the standard system of installation adopted and that the ratings of furnaces should be based on actual tests performed by disinterested persons. Accordingly, the executive committee of the league was instructed to have prepared for the league a standard system for installing furnaces and to take such steps as they might deem necessary to carry on the testing and rating of furnaces in accordance with the standard system adopted.

THE LEAGUE'S TESTING STATION

A building was erected and equipped, and in the latter part of January, 1911, I received notice that the engineering department of the league was to take charge of the testing station on February 1, and I was instructed to carry on the work of testing furnaces as rapidly as circumstances would permit.

EQUIPMENT OF TESTING STATION

The testing station, located at Newton Square, Pa., is a two-story frame building about 60 ft. long by 16 ft. wide. The first story is used as a furnace room and is provided with four permanent furnace foundations and underground cold-air ducts (the inlet to each cold-air duct being controlled by a hinged door); with four permanent smoke-flues (with an electric pyrometer for reading the temperature of gases leaving the furnaces), and with eight heat-pipe connections to the second story of the building. On the second floor are the eight heat-pipe outlets, two for each furnace, with a recording anemometer and a standard thermometer for each pipe.

This equipment makes four complete testing stations of graded sizes, as follows:

Station No. 1.—(For furnaces up to 20 in. average fire-pot diameter), has a foundation for furnaces with 32 in. to 44 in. casing diameters, cold-air duct 10 in. x 22 in., smoke-flue (36 ft. above grate), 7 in. diameter, two 14-in. diameter heat pipes connected to two riser pipes, each with a net cross-section area of 1.03 sq. ft.

Station No. 2.—(For furnaces with 20 in. to 24 in. average fire-pot diameter), has a foundation for furnaces with 40 in. to 52 in. casing diameters; cold-air duct 12 in. by 26 in.; smoke-flue (36 ft. above grate), 8 in. diameter; two 17-in. diameter heat pipes connected to two riser pipes, one with

*Presented at the annual meeting of the Federal Furnace League, in New York, May 9, 1911.

a net cross-section area of 1.435 sq. ft. and the other with a net cross-section area of 1.42 sq. ft.

Station No. 3.—(For furnaces with 24 in. to 29 in. average fire-pot diameter), has a foundation for furnaces with 50 in. to 62 in. casing diameters; cold-air duct 14 in. by 34 in.; smoke-flue (36 ft. above grate), 9 in. diameter; two 20-in. diameter heat pipes connected to two riser pipes, one with a net cross-section area of 2.08 sq. ft. and the other with a net cross-section area of 2.10 sq. ft.

Station No. 4.—(For furnaces with 29 in. to 36 in. average fire-pot diameter), has a foundation for furnaces with 60 in. to 72 in. casing diameters; cold-air duct 18 in. by 44 in.; smoke-flue (36 ft. above grate), 12 in. diameter; two 20 in. by 25 in. square collars tapered to 25 in. diameter heat-pipes connected to two riser pipes, each with a net cross-section area of 3.35 sq. ft.

HOW THE READINGS WERE TAKEN

After the riser pipes and the permanent sheet metal work were all in place, the pipes were standardized by placing at the center of the pipe the anemometer that in future was to be used in the pipe, and by placing other anemometers at various points in the pipes. Readings for a period of 10 min. were taken and the positions of the anemometers were changed (except the center anemometer) and another reading taken. This was repeated from three to five times on each pipe until practically the entire area of the pipe had been compared to the center. This procedure was followed out not once, but several times on each pipe, the work taking more than two weeks to complete, and when the results of these repetitions were compared, the variation was found to be less than .005. From the complete series of results on each pipe an average was struck and is now in use.

These standard ratios are as follows:

Station No. 1, pipe No. 1, aver. reading, Center ×1.043
pipe No. 2, aver. reading, Center ×1.108
Station No. 2, pipe No. 1, aver. reading, Center ×1.08
pipe No. 2, aver. reading, Center ×1.376
Station No. 3, pipe No. 1, aver. reading, Center ×1.172
pipe No. 2, aver. reading, Center ×1.225
Station No. 4, pipe No. 1, aver. reading, Center ×1.272
pipe No. 2, aver. reading, Center ×1.141

The fact that the average in every case is greater than the center reading is due to the curved baffles at the base of the riser pipes, causing an increased velocity of flow of air at the back of the pipe. The variations in ratio are due to variations in the curve of the baffle plates.

In addition to these corrections for velocities in pipes, it is necessary to make an allowance for variations in heat losses in pipes. The proportion of uncovered pipe surface on the other stations is not as great as on Station No. 1, accordingly we had to find a standard ratio to equalize the heat loss on the other stations.

A rough estimate was made and compared with results obtained by interchanging furnaces from one station to another. By this method we obtained corrections for heat losses in pipes as follows:

Station No. 1—Multiply total test results by 1.000
Station No. 2—Multiply total test results by .988
Station No. 3—Multiply total test results by .963
Station No. 4—Multiply total test results by .988

The heat loss in pipes as corrected represents a little more than 20% of the heat delivery at the outlets—*i. e.*, the furnaces deliver at the crown a little more than 120% of the amount of heat recorded at the outlets. For the purpose of rating, we use the delivery at outlets, assuming that the heat lost in uncovered pipes at the testing station does not exceed the heat loss in covered pipes in an actual installation (the Federal system requires all heat pipes to be covered with a good non-conducting covering).

In addition to these fixed corrections, there are corrections for fuel consumed in each test and corrections for average temperature of air passing through the furnace.

LOW-GRADE ANTHRACITE COAL USED

The coal used for testing is a low-grade anthracite, stove size, with a large percentage of cinder and ash, and a low heat value. This low-grade fuel was ordered so that we might be certain that the fuel used in the tests was not better than that used in furnaces in actual operation.

The correction for coal consumption will necessarily vary with different

samples of coal, and although it can be worked out theoretically, the theoretical correction does not include the latent heat in the ashes and cinders of the residuum, which varies with the condition of the fire and temperature of the residuum. The correction for fuel now in use at the testing station is as follows:

Pounds of residuum minus 14% of the total weight of wood and coal used equals pounds of carbon which, when multiplied by 16,000, equals B. T. U. of heat in residuum and this total when divided by 12,000 equals the value in pounds of coal, which, when subtracted from the weight of coal put into the furnace, gives the actual amount of coal consumed. This amount is divided into the amount of coal the furnace should burn in eight hours, and the resulting fraction is used as a factor to correct the test results to the standard.

The correction for average temperature of air passing through the furnace is obtained as follows: Under the Federal system the maximum register temperature is 150° F., corresponding to a temperature of over 180° F. at collars on bonnet of furnace. It is assumed that the average temperature of air passing over the heating surfaces in the furnace would be 100° F., or two-thirds of 150° F. (the register temperature). From the average temperature of air at outlets, we subtract the average outdoor temperature and add two-thirds of the remainder to the average outdoor temperature. From this sum we subtract 100, and the remainder represents the number of parts per 1,000 the increased temperature has diminished the air heating power of the furnace. This factor is used to correct the results obtained in the tests to the results that would have been obtained under zero weather conditions.

THE METHOD OF TESTING

The method of testing is rather complicated and a description without illustration would be very confusing. Probably the best way to describe the method of testing would be to conduct an imaginary test on a No. 548 "Hot Stuff" furnace, manufactured by the "Hot Stuff" Heater Co.

The furnace is described in the catalogue as a 25-in. diameter fire-pot with a 48-in. diameter casing. The manufacturers have shipped the furnace to us with two 20-in. diameter outlets in the bonnet.

Before the furnace was set up in the testing station we measured the fire-pot and found the dimensions to be as follows:

Diameter at top of fire-pot	25	in.
Diameter at bottom of fire-pot	22	in.
Average diameter of fire-pot	23.5	in.
Depth of fire-pot	16	in.

(Depth of fire-pot in tests is limited to 15 in.)

On this basis the cubic contents of the fire-pot are:

$23.5'' \times 23.5'' \times 0.7854 \times 15'' = 506$ cu. in.
$6506 \div 1728 = 3.765$ cu. ft. $\times 64 = 241$ lbs. coal.

The furnace had an average fire-pot diameter less than 24 in. and was set up on Station No. 2 and connected to the 17-in. diameter round heat pipes by 20 in.-17 in. tapering joints of the pipe. The smoke outlet of the furnace (8 in. diameter) was the same size as the smoke flue of Station No. 2. Paper and 24 lbs. of wood (10% of the coal capacity of the fire-pot) were placed in the fire-pot, and at 8.40 A. M. the fire was lighted. At 9 A. M. the fire was examined and the wood was found to have burned to red-hot coals, accordingly 96 lbs. of coal (40% of the coal capacity of the fire-pot) were put in the fire-pot and all drafts turned on and the anemometers in the heat pipes started. At 9.30 A. M. the temperature of the air at each outlet pipe was taken and recorded separately, and the outdoor temperature was taken and recorded. After the temperatures were recorded, 145 lbs. of coal (60% of the coal capacity of the fire-pot) were placed in the fire-pot.

At 10 A. M. the temperature of air at each outlet pipe was taken and the outdoor temperature was taken again and these temperatures were recorded in spaces on the test card alongside of those taken at 9.30 A. M. These temperatures were taken every 30 min. until the end of the test at 5 P. M.

At 10 A. M. the smoke-flue temperature was recorded, and was recorded every hour thereafter until 5 P. M.

At 10.30 A. M. the ash-pit door of the furnace was closed and the draft door set open at the first notch. The condition of the fire was noted every hour, and at 2 P. M. it became apparent that the coal was being consumed a trifle too rapidly. The draft door was closed, and at 4 P. M. the draft door was again opened one notch. At 5 P. M. all temperatures were recorded, the anemometers were stopped and the fire was dumped. The ashes, cinders and burning coals were scraped out of the ash-pit and weighed. The weight of this residuum was 60 lbs. The record at the end of the test was substantially as follows:

SPECIMEN FEDERAL FURNACE LEAGUE TEST CARD NO. Z

Manufacturer, HOT STUFF HEATER CO.

No. 548. Name, Hot Stuff. Station No. 2.

Pipe Correction— x 0.988.

Fire-pot capacity, 3.765 cu. ft. Coal capacity, 241 lbs.

Wood used, 24 lbs. First charge of coal, 96 lbs. Second charge of coal, 145 lbs.

Should burn in 8 hrs. 193 lbs. coal. Actually burned in 8 hrs. 210.5 lbs. coal.

OBSERVATIONS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Average
Pipe No. 1 Temp. Deg. F.	143	148	230	238	249	256	257	256	254	255	229	227	228	209	181	160	220
Pipe No. 2 Temp., Deg. F.	149	154	232	237	251	261	263	263	258	257	230	229	233	215	188	164	224
Outdoor Temp., Deg. F.	55	55	56	57	58	59	60	60	61	62	62	61	60	60	59	59	59
Chimney Temp., Deg. F.	...	340	...	660	...	640	...	620	...	600	...	480	...	440	...	380	520

Pipe No. 1—Anemometer C—Finish..... 2,227,742
Area—1.435 sq. ft.—Start..... 2,025,788

Correction—x 1.08 480) 201,954(420
2 correction

422 ft. per min.

Pipe No. 2—Anemometer D—Finish..... 2,275,906
Area—1.42 sq. ft.—Start..... 2,087,371

Correction—x 1.376 480) 188,535(393
3 correction

396 ft. per min.

422 × 480 × 1.435 × 1.08 = 313,927 cu. ft. 396 × 480 × 1.42 × 1.376 = 371,401 cu. ft.

313,927 × .0585 × 161 × .238 = 703,700 B.T.U. 371,401 × .0581 × 165 × .238 = 847,384 B.T.U.

1,551,084 B.T.U. × [(.988 × 193/210.5) + 9.324] = 1,409,158 B.T.U.

1,409,158 B.T.U. ÷ 8 = 176,145 B.T.U. per hr. delivered at registers.

176,145 B.T.U. + 20% = 211,374 B.T.U. per hr. at bonnet of furnace.

Date of test, May 9, 1911. Engineer in charge, Wm. F. Colbert.

TESTS DETERMINED MAXIMUM CAPACITY

The tests as conducted are maximum-capacity tests, not efficiency tests. On the furnaces tested, by varying the rate of combustion to produce a proper ratio between the pounds of coal burned per hour and the square feet of heating surfaces in the furnace we could produce from 5% to 35% increases in percentage efficiencies.

The rate of combustion in the tests is a trifle high when the fire-pot depth is 15 in. or over, but it must be borne in mind that only the larger-size furnaces have such deep fire-pots. In fire-pots less than 15 in. deep the rate of combustion is diminished in proportion. It is also to be remembered that the furnaces are rated on the basis of the Federal system of heating, in which the allowances for heat losses are very high to cover poor building construction. In a good building the furnace will carry its rated load on a much lower rate of fuel consumption than was required of it in the tests.

Finally, it should be borne in mind that the average rate of combustion during an entire heating season is only about one-half the combustion rate in zero weather, which means that throughout the heating season a furnace will show a decided increase in heating efficiency over that obtained in the tests conducted in the basis of zero weather heating requirements.

The accuracy of the method of testing and of the results obtained can only be demonstrated by control tests. The official tests on several furnaces

have been repeated from time to time for the purpose of checking results and demonstrating the accuracy of the method. To date the variation in final results have not exceeded .0063; notwithstanding the fact that the tests have been made at an interval of ten days or more, with variations of nearly 20° in outdoor temperatures, with variations in wind velocities and with variations in rate of combustion amounting to 3%.

I believe that these control tests have demonstrated that our test results are as accurate as can reasonably be expected and that our method of testing furnaces produces results more accurate than those heretofore described in the literature on the subject.

A New Basis for Rating House-Heating Boilers*

DEVELOPMENT OF A FORMULA WITH THE TERM HORSEPOWER AS THE UNIT OF HEATING EFFECT

By Frank L. Busey

For small medium-sized heating installations, steam and hot-water boilers and warm-air furnaces are used for the same class of work, depending on the requirements and available funds. Each has its own advantages and its own advocates, so there should be some common or comparable basis of rating, or of making a comparison of the results to be expected from the various units. This rating should be expressed in some small quantity, in order that it be easily handled and comprehended. It should be, if possible, in some well-known and established term, such as American Society of Mechanical Engineers standard horsepower, universally used in referring to large power and heating boilers. Heating installations will usually range between 2 and 50 H.P., where the installation is intended strictly for heating purposes.

The question of a fair and proper rating for house-heating apparatus has often been discussed, without definite results, and the need of a solution to the problem is sorely felt by all who come in contact with the boiler and furnace business. Some manufacturers are equipped to test their boilers properly, and so arrive at a fairly accurate determination of what performance their product is capable. On the other hand, a considerable number of builders have no adequate means of conducting tests and would be unable to interpret the results in case such tests were made. These are the parties who are guilty of placing apparatus on the market which has a catalogue rating of two to three times what can be developed under normal working conditions. As a result, the business is in an unsatisfactory state as regards ratings, and the crying need of the trade is for some uniform system whereby the heating capacities of the various types of boilers and furnaces may be closely approximated from the design and dimensions of the unit under consideration.

An appreciation of this need has led the writer to turn his attention to the rating question, with the result that a number of interesting conclusions have been derived. These results will be presented herewith, together with the methods by which they were obtained. A study was made of several hundred tests made by the University of Illinois Engineering Experiment Station on various types and sizes of small boilers and furnaces, and also of tests made on other and larger units, the results of which could be relied upon.

*Presented at the semi-annual meeting of The American Society of Heating and Ventilating Engineers, Chicago, July 6-8, 1911.

The practice of using 10 or 12 sq. ft. of heating surface in a boiler as equivalent to 1 H.P. is hardly warranted in house-heating boiler work, since the rate of combustion, ratio of heating surface to grate area and consequent variation in efficiency may invalidate such a system. As a matter of fact, the amount of surface required may vary anywhere from 5 to 50 sq. ft. per horsepower, depending on the conditions mentioned.

HORSEPOWER AS THE UNIT OF HEATING EFFECT

Various combinations were tried and discarded, and it was finally decided to use the term horsepower as the unit of heating effect, as applicable to both steam boilers and warm-air heaters. Taking the A. S. M. E. standard of 34.5 lbs. of water evaporated per hour from and at 212° F. as equivalent to 1 B.H.P., we have $34.5 \times 970.4 = 33{,}479$ B.T.U. as also equal to 1 H.P. In the case of the boilers, the equivalent evaporation from and at 212° F. per hour divided by 34.5 gives the horsepower developed. With the warm-air furnaces the pounds of air heated per hour multiplied by the rise in temperature and the specific heat of air, gives the number of B.T.U. delivered per hour to the air. This in turn divided by 33,479 gives the horsepower developed by the furnaces.

GRATE AREA AND RATE OF COMBUSTION

Having determined the total horsepower developed by the various units tested, the next step was to find some dimension, relation, or ratio to which the horsepower developed could be referred, and so obtain a unit to which the horsepower would bear some definite relation. It was found that the horsepower developed upon each square foot of grate by 1 lb. of dry fuel burned per hour on each square foot of grate surface was remarkably constant. This is true for any one boiler or furnace when burning dry coal per square foot of grate per hour between the limits of 4 to 8 lbs. for small units and 5 to 10 lbs. for the larger units, and when using coals of a similar quality. This is shown very clearly in Figs. 1 and 2 for two separate units, each using two classes of fuel. This value, termed a horsepower constant, and designated by the letter K, was obtained for each test analyzed, by dividing the horsepower developed by the grate area, and this quantity in turn by the rate of combustion. Since

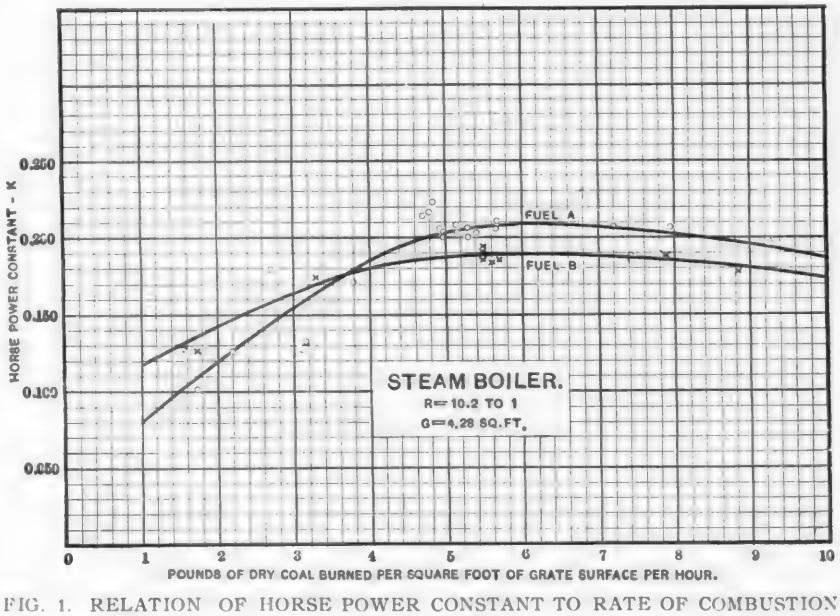


FIG. 1. RELATION OF HORSE POWER CONSTANT TO RATE OF COMBUSTION

frequent reference will be made to the grate area and the rate of combustion for any one heating unit, these terms will be designated by the letters G and F, respectively.

DEFINITE RELATION BETWEEN K AND R

While K was constant for any one unit and for similar quality of coal, yet different units gave different values of K. It was found that the higher values of K were obtained from units having a greater number of square feet of heating surface for each square foot of grate, this number being the ratio of the total square feet of heating surface to the square feet of grate. This ratio will be designated by the letter R. For a similar quality of coal, the values of K from the different units were then plotted to the corresponding values of R, as shown in Fig. 3. It is seen that there exists a very definite relation between the values of K and R.

This relation appears reasonable, for, other conditions being equal, higher efficiencies will be obtained with higher values of R. Thus in practice it is customary to use additional sections, resulting in higher values of R, and also greater capacity. The relation between K and R was found to be independent of the size of the unit tested, inasmuch as increase in size actually accompanied by the increasing value of R. This accounts for the higher efficiencies obtained from large units.

It is well to know that the use of various grades of coal results in different efficiencies in the same unit. From a study of the tests made it was found that the coals used could be divided into three general classes, designated as classes A, B and C. Class A includes anthracite, coke and semi-bituminous coals. Class B includes good grades of bituminous coal, such as is mined in Williamson, Franklin and Saline counties of the southern District of Illinois. Class C includes the poorer grades of bituminous coals. We have already seen that when using any one class of a coal a definite relation exists between K and R. Although different values of K are obtained when using the different classes of coal, yet each class has its own definite relation between K and R. This is well illustrated in Fig. 3, where the three curves refer to the different classes of fuel.

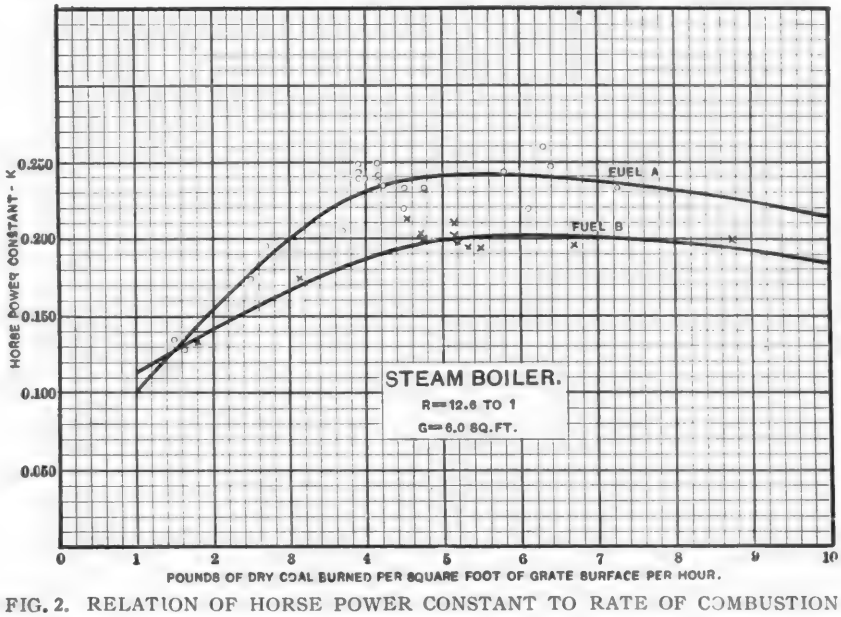


FIG. 2. RELATION OF HORSE POWER CONSTANT TO RATE OF COMBUSTION

COAL ANALYSES

Table 4 shows the average proxi-

TABLE 4

AVERAGE PROXIMATE ANALYSIS OF FUELS USED, FUEL AS FIRED

	Fixed Carbon Per Cent.	Volatile Per Cent.	Moisture Per Cent.	Ash Per Cent.	Sulphur Per Cent.	B.T.U. Per Lb.
Class A—Anthracite	78.25	7.13	3.49	11.15	1.30	12820
Coke	80.50	3.26	6.30	9.94	0.90	12015
Semi-Bituminous	74.57	18.79	1.49	5.15	0.74	14780
Class B—Bituminous	49.07	34.91	6.84	9.19	1.82	12250
Class C—Bituminous	41.59	38.05	10.79	9.57	2.97	11340

mate analyses of the three classes of coals as they were used during these tests. The term "good" or "poor," as here used, refers to the performance of the coal when used in small house heating units and not for large power boilers. The comparatively low furnace temperatures attained in the smaller furnaces make it impossible to burn completely the excessive amounts of volatile matter contained in these coals designated as "poor bituminous." For this reason they soot up the flues and cut down the efficiency.

DIFFERENCE IN EFFICIENCY OF BOILER

It is customary in order to get the same heating effect to build warm-air furnaces with a much greater value of R than is used with steam and hot water boilers. This is on account of the fact that more heat can be transmitted through one square foot of heating surface to water than to air. Tests show that in warm-air furnaces R must be from two to three times as large as in boilers to give the same efficiency, and correspond very closely with practice.

As a result of these facts, K does not bear the same relation to R in furnaces as in boilers, due to the greater value of R necessary in furnaces to obtain the same value of K. It follows that the relation of K to R varies, not only with the different class of fuels used, but

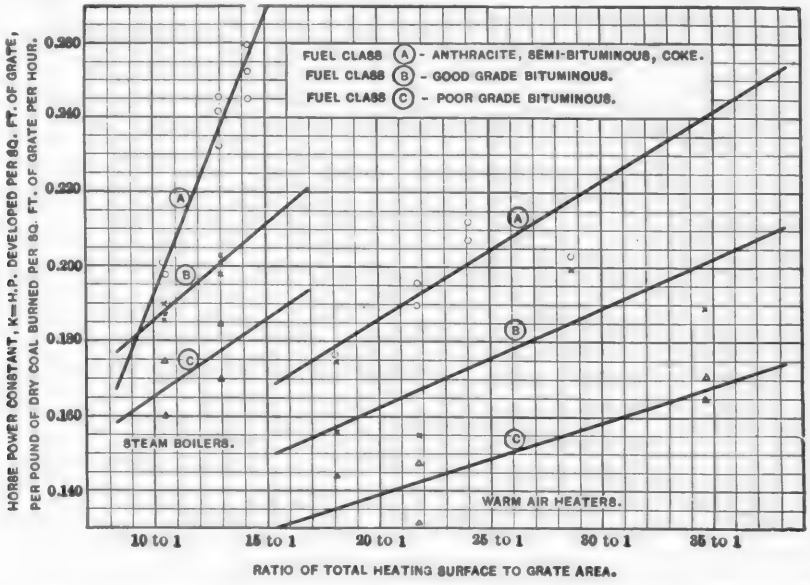

HORSE POWER CONSTANT, K=H.P. DEVELOPED PER SQ. FT. OF GRATE, PER POUND OF DRY COAL BURNED PER SQ. FT. OF GRATE PER HOUR.
0.260
0.240
0.220
0.200
0.180
0.160
0.140
FUEL CLASS (A) - ANTHRACITE, SEMI-BITUMINOUS, COKE.
FUEL CLASS (B) - GOOD GRADE BITUMINOUS.
FUEL CLASS (C) - POOR GRADE BITUMINOUS.
STEAM BOILERS.
WARM AIR HEATERS.
10 to 1
15 to 1
20 to 1
25 to 1
30 to 1
35 to 1
RATIO OF TOTAL HEATING SURFACE TO GRATE AREA.

FIG. 3. RELATION OF HORSE POWER CONSTANT TO RATIO OF HEATING SURFACE TO GRATE AREA

with the different type of heating unit, being clearly shown in Fig. 3.

Fig. 3 shows the relation between the horsepower constant K and the ratio of total heating surface to grate area R. The general relation of the curves A, B and C for furnaces and curves B and C for boilers is seen to be very similar, the better fuels giving the higher efficiencies. This difference increases slightly as the value of R increases. An increase in the value of R is accomplished by an increase in the value of K only in so far as the value of R is confined to the limits found in practice.

These limiting values of R for boilers in which this relation was found to hold are between 8 and 15. This range for furnaces, however, is from 15 to 38. It is quite probable that the higher value of 15 set for R in the case of boilers can be increased to 20 or even above, but it was impossible to obtain sufficient data to prove absolutely this point. Nevertheless the indications are that this is the case. There would eventually come a point where the temperature of the flue gases would be reduced to so nearly the temperature of the surrounding water or air that no further gain would be effected by increasing the radiating surface.

Curve A, in the case of the boilers, shows a much greater difference in favor of the high carbon over the bituminous coals as the radiating surface increased. This difference is probably due to the comparatively restricted flue passages as ordinarily used in steam and hot water boilers, in which the soot from the bituminous soals tends to deposit and so cut down the efficiency. In warm-air heaters the radiator is usually made of such ample proportions that less difficulty is experienced with soot deposits. If the ratio of heating surface to grate could be increased, and at the same time the gas passages kept of ample size, curves B and C would no doubt tend to assume an inclination more nearly like that of curve A.

It is evident that an increase in the radiating surface of boilers is productive of greater gain in efficiency when using Class A fuels rather than the ordinary bituminous coals. With boilers having a low value of R good grade of bituminous coal may be expected to give as good results as are to be obtained with anthracite or eastern semi-bituminous coals.

Having found that the values in Fig. 3 can be represented by straight lines within the limits of the tests used, the next step was to derive a formula and determine the proper constants applicable to the various sets of conditions.

Let G = Area of grate surface in sq. ft.
F = Pounds of dry fuel burned per sq. ft. of grate surface per hour.
R = Ratio of total heating surface to grate area.
K = Horsepower constant = h.p. developed per sq. ft. of grate, per lb. of dry fuel burned per sq. ft. of grate per hour.
H.P. = Total horsepower developed.
C_1 and C_2 = Constants for any one set of conditions.

It will be noticed that the average deviation of the points from the lines as drawn is less than 3%, and that the maximum deviation is 7.5%. This shows how closely actual performance, as shown by a study of several hundred tests, may be approximated by the use of the formulæ and constants given in Table 1.

Then these lines are represented by a formula of a form

$$K = C_1R + C_2$$

In this formula C_1 and C_2 have definite values for any one set of conditions—that is, for one type of heating unit in various sizes, when using one class of coal.

The various sets of values for C_1 and C_2 have been carefully determined and are tabulated in Table 1. Thus the formula for warm-air heaters for a fuel in class A becomes

$$K = 0.0037R + 0.112$$

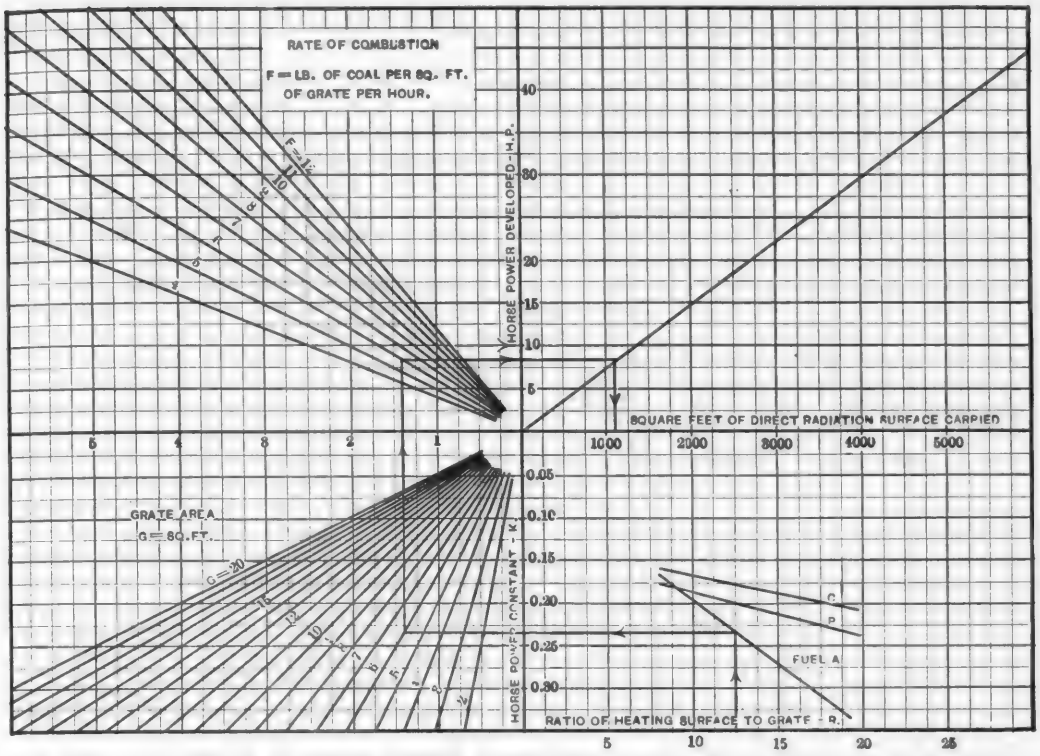

RATE OF COMBUSTION
F = LB. OF COAL PER SQ. FT.
OF GRATE PER HOUR.
HORSE POWER DEVELOPED - H.P.
SQUARE FEET OF DIRECT RADIATION SURFACE CARRIED
GRATE AREA
G = SQ. FT.
HORSE POWER CONSTANT - K.
FUEL A
RATIO OF HEATING SURFACE TO GRATE - R.

FIG. 4. DIAGRAM OF HORSE POWER DEVELOPED AND LOAD CARRIED BY VARIOUS SIZES OF BOILERS

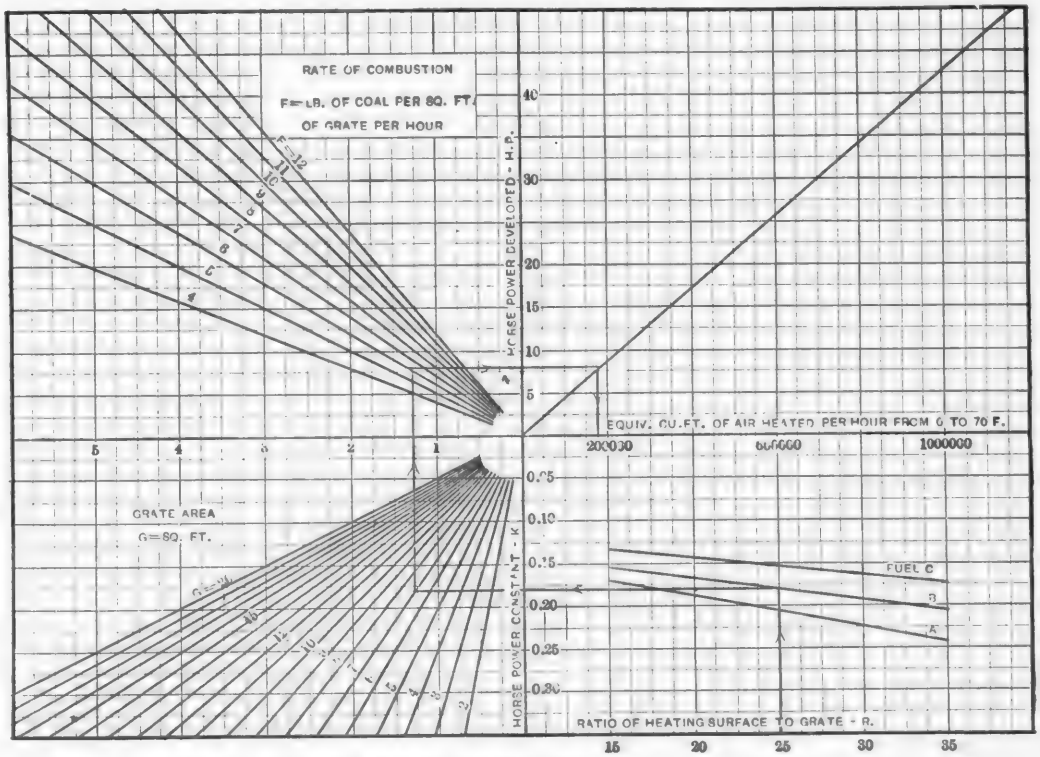

RATE OF COMBUSTION
F = LB. OF COAL PER SQ. FT.
OF GRATE PER HOUR
HORSE POWER DEVELOPED - H.P.
EQUIV. CU.FT. OF AIR HEATED PER HOUR FROM 0 TO 70 F.
GRATE AREA
G = SQ. FT.
HORSE POWER CONSTANT - K.
FUEL C
RATIO OF HEATING SURFACE TO GRATE - R.

FIG. 5. DIAGRAM OF HORSE POWER DEVELOPED AND LOAD CARRIED BY VARIOUS SIZES OF FURNACES

TABLE 1

VALUES OF C_1 AND C_2 FOR THE FORMULA $K=C_1R+C_2$

	Fuel	C_1	C_2
Steam Boilers.....	Class A—Anthracite, Semi-Bituminous, Coke..	0.0150	0.046
	" B—Good Grade Bituminous.....	0.0052	0.135
	" C—Poor Grade Bituminous.....	0.0041	0.126
Warm-Air Heaters...	Class A—Anthracite, Semi-Bituminous, Coke..	0.0037	0.112
	" B—Good Grade Bituminous.....	0.002	0.110
	" C—Poor Grade Bituminous.....	0.0020	0.101

For any unit under consideration this formula gives us the value of K, or the horsepower that is developed on each square foot of grate surface by each pound of fuel burned per square foot of grate per hour. Knowing K, the grate area, and the most desirable rate of combustion, the total horsepower developed can be readily determined by the formula

$$H.P. = K \times G \times F$$

The A. S. M. E. standard of 34.5 lbs. of water evaporated as one horsepower was used, hence 1 H.P. = 33,479 B.T.U. This in turn divided by 250 gives the number of square feet of direct radiating surface carried—taking the standard of 250 B.T.U. emitted per square foot per hour. With warm-air furnaces the B.T.U. delivered to the air per hour divided by 1.4356 (the heat required to raise 1 cu. ft. of air from zero to 70° F.

As previously explained, the value of K, of the B.T.U., or of the heating effect, as given in Tables 2 and 3, when multiplied by G and F give the total horsepower developed, total B.T.U delivered, or total heating effect, under the conditions assumed. Fig. 4 for boilers and Fig. 5 for furnaces have been drawn to show more clearly the effect of the various combinations of the factors already discussed. From these figures can be readily traced the entire course from heat unit to the horsepower developed for any set of conditions.

HOW TO USE CHARTS

Referring to Fig. 4 let us assume a boiler with a value of R=12.5, a grate area of 6 sq. ft. and a rate of combustion of F=6 lbs. Then, if we are to use anthracite, we will follow the vertical line upward from the point where R=12.5 until we intersect the line A. From this intersection we follow the horizontal line to the left through the point K =0.235 until we intersect the line G =6. From this point we trace the vertical line upward until we reach the line F=6. Following the horizontal line to the right from this point it is seen that under these conditions the horsepower developed is 8.5. On tracing it farther to the right until we intersect the diagonal line, then dropping downward on the vertical line we find the equivalent heating surface served to be 1,150 sq. ft.

In the same manner for warm-air furnaces on Fig. 5, the values can be traced as shown. From R=25, fuel B, G=7, F=6, to 7.8 H.P. or a heating effect of 180,000 cu. ft. of air warmed per hour from zero to 70° F. This operation can be reversed, with either Fig. 4 or 5, thus working from the amount of heat needed back to the unit to be selected.

CONCLUSIONS

(a) Any basis of rating selected for heating installations should be equally applicable to steam and hot water boilers and to warm-air furnaces, as they are used for similar requirements.

(b) A unit of rating should be of such a character that it may be easily expressed and comprehended, of some standard form that may be compared to that used for power boiler rating.

TABLE 2.—VALUES OF HORSE-POWER CONSTANT *K* FOR VARIOUS VALUES OF RATIO *R*, STEAM BOILERS

R Ratio of Total Heating Surface to Grate Area	Fuel A			Fuel B			Fuel C		
	K Horse Power Constant	B.t.u. per Hour Delivered to the Water	Square Feet of Radiation Served	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Water	Square Feet of Radiation Served	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Water	Square Feet of Radiation Served
8 to 1	0 166	5560	22.2	0.177	5925	23.7	0.159	5320	21.3
9 "	0.181	6060	24.2	0.182	6090	24.4	0.163	5455	21.8
10 "	0.196	6560	26.2	0.187	6260	25.0	0.167	5590	22.4
11 "	0.211	7065	28.3	0.192	6430	25.7	0.171	5730	22.9
12 "	0.226	7565	30.3	0.197	6595	26.4	0.175	5865	23.5
13 "	0.241	8065	32.3	0.203	6785	27.1	0.179	6000	24.0
14 "	0.256	8570	34.3	0.208	6960	27.8	0.183	6135	24.5
15 "	0.271	9070	36.3	0.213	7130	28.5	0.188	6280	25.1
16 "	0.286	9575	38.3	0.218	7300	29.2	0.192	6420	25.7
17 "	0.301	10075	40.3	0.223	7465	29.9	0.196	6550	26.2
18 "	0.316	10575	42.3	0.229	7665	30.7	0.200	6690	26.8
19 "	0.331	11080	44.3	0.234	7835	31.3	0.204	6830	27.3
20 "	0 346	11580	46 3	0.239	8000	32.0	0.208	6965	27.9

(c) The term horsepower as used in the A. S. M. E. rating for power boilers is a measure of heat delivered, is applicable to both boilers and furnaces, and fulfills better than any other term the above requirements.

(d) The heat generated, or the power developed, on each square foot of grate by the combustion of 1 lb. of fuel on that square foot of grate, has been found to be practically a constant, under the conditions as already outlined. This is true of both boilers and furnaces.

(e) This constant bears a definite relation to the size of the heating unit, as expressed by the ratio of its total heating surface to grate area. Based on the results of actual tests, this relation can be expressed by a simple formula and the above constant determined for different units and sets of conditions.

TABLE 3.—VALUES OF HORSE-POWER CONSTANT *K* FOR VARIOUS VALUES OF RATIO *R*, WARM AIR HEATERS

R Ratio of Total Heating Surface to Grate Area	Fuel A			Fuel B			Fuel C		
	K Horse Power Constant	B.t.u. per Hour Delivered to the Air	Equivalent Cu. Ft. of Air Heated per Hour from 0° to 70°F	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Air	Equivalent Cu. Ft. of Air Heated per Hour from 0° to 70°F	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Air	Equivalent Cu. Ft. of Air Heated per Hr. from 0° to 70°F
15 to 1	0.168	5610	3906	0.151	5040	3511	0.131	4385	3054
16 "	0.171	5730	3993	0.153	5130	3573	0.133	4455	3103
17 "	0.175	5855	4078	0 156	5220	3636	0.135	4520	3148
18 "	0.179	5980	4165	0 159	5310	3699	0.137	4585	3194
19 "	0.182	6105	4251	0.161	5400	3761	0.139	4655	3243
20 "	0.186	6225	4338	0.164	5490	3824	0.141	4720	3288
21 "	0.190	6350	4424	0.167	5580	3887	0.143	4785	3333
22 "	0.193	6475	4510	0.169	5670	3950	0.145	4855	3382
23 "	0.197	6600	4597	0.172	5760	4012	0.147	4920	3427
24 "	0.201	6725	4683	0 175	5850	4075	0.149	4990	3476
25 "	0.205	6845	4769	0.178	5940	4138	0.151	5055	3521
26 "	0.208	6970	4855	0.180	6035	4204	0.153	5120	3566
27 "	0.212	7095	4942	0.183	6125	4266	0.155	5190	3615
28 "	0.216	7220	5028	0 186	6215	4329	0.157	5255	3660
29 "	0.219	7340	5114	0 188	6305	4392	0.159	5325	3709
30 "	0 223	7465	5201	0.191	6395	4455	0.161	5390	3754
31 "	0.227	7590	5287	0.194	6485	4517	0.163	5455	3800
32 "	0.230	7715	5373	0.196	6575	4580	0.165	5525	3849
33 "	0.234	7835	5459	0.199	6665	4643	0.167	5590	3894
34 "	0.238	7960	5545	0.202	6755	4705	0.169	5660	3943
35 "	0 242	8085	5632	0.205	6845	4768	0.171	5725	3988
36 "	0 246	8210	5718	0 208	6935	4831	0 173	5795	4034

(f) The difference between the horsepower developed by actual test and that calculated by the use of this formula is comparatively slight. The calculated horsepower may be used in connection with the ordinary heating job, with entire satisfaction.

(g) The use of the diagrams Figs. 4 and 5 will expedite the work of calculation, and for any ordinary case is sufficiently accurate. Where greater accuracy is desired the formula and the values of C_1 and C_2 from Table 1 may be used.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Semi-Annual Meeting, Chicago, July 6-8, 1911

After providing a three-day hot spell of record-breaking intensity, the Chicago weather man, scenting the approaching heating engineers from afar, discreetly changed his tactics and served a brand of weather for their mid-summer meeting that approached the ideal. Prepared to withstand the city's heat as best might be, arrangements had been made to hold the professional sessions on the nineteenth floor of the La Salle Hotel. Here with two sides exposed to the lake, it was hoped that some relief would be offered by the lake breezes. As it turned out, the opening session was called to order with a miniature gale sweeping through the assembly room, actually compelling the closing of the French windows on both exposed sides.

Under these delightful weather conditions, which continued throughout the meeting, a programme of unusual variety and interest was successfully carried out. The registered attendance was 107.

MORNING SESSION, JULY 6

The first session was opened with the president, Reginald Pelham Bolton, in the chair. George Mehring, of the Illinois Chapter, welcomed the society to Chicago, paying a glowing tribute to the influence of the visiting members in dispelling the city's heat wave.

Mr. Mehring was followed by J. F. Wing, of the Chicago Association of Commerce, who extended a welcome on behalf of his association.

President R. P. Bolton then presented his address which was a decided departure from the customary type of address, being in the form of a study of the effects upon the climatic conditions of New York City by the vast quantity of heat emanating from its industries and from the heating of its buildings.

Mr. Bolton showed that the occurrences of zero temperature and below in New York City are becoming rare and, at the same time, the precipitation during the winter months is also falling off. He cited the fact that the amount of coal consumed in 1900 for the generation of power for transit purposes was 1,343,573 tons. During the same period the electrical lighting companies consumed 884,757. These two items, together with the amounts of coal used for the production of gas, in breweries, in private power plants, in domestic plants and in river tugs and vessels, together with the amount of oil consumed, 137,000 gals. per year, brings the total annual consumption of coal or its equivalent to a total of 18,950,000 net tons, or enough to add 3½° F. to the temperature of the atmosphere, one-half mile in height, over an area of 130 square miles, covering the principal portions of the city.

The effect of this addition to the heat of the atmosphere on decreasing the precipitation was explained by Mr. Bolton on the ground that this increase in the temperature would add about 3½% to the moisture absorbing capacity of the atmosphere. Mr. Bolton attributed the foggy condition in and about London to this cause.

In reporting the work of the Illinois Chapter, Samuel R. Lewis, referred to the critical illness of James Mackay, one of its most prominent members, and at his suggestion a resolution was passed extending the greetings and good will of the society to Mr. Mackay.

Prof. James D. Hoffman, general chairman of the Compulsory Legislation Committee, told of the new ventilation laws passed in Indiana, Kansas and North Dakota, which have been published in these columns. He also told of the progress of similar bills in New York (for factories), Massachusetts, Nebraska and Wisconsin.

Prof. Hoffman expressed an opinion that was warmly endorsed by other speakers that the committee should draw up a so-called ideal ventilation law, to be known as the "standard" ventilation law. With such a basis to work on, the various state committees could then proceed to incorporate as many of these features in their proposed legislation as was found practicable.

Mr. Theodore Weinshank told how the Indiana ventilation law was modified, before passage, by the elimination of one word, "only." The original bill read, "no schoolhouse to be heated by direct radiation only." By leaving out this word, said Mr. Weinshank, the use of direct or direct-indirect heating system is prohibited in schoolhouses in Indiana.

Mr. A. S. Armagnac called attention to the fact that in Ohio a building code, recently enacted, contained a reference to the ventilating of theatres and similar places of assembly, the code providing that such buildings shall be supplied with at least 1,200 cu. ft. of fresh air per occupant per hour.

Reporting for the Committee on Heating Guarantees, Mr. W. M. Mackay read a number of letters favoring the proposition that the designing engineer should guarantee his designs and that the contractor can only be rightly held for the proper installation and for the materials, that is, for the complete performance of his contract. This view, said Mr. Mackay, was one which he also shared.

This disposed of the committee reports and the first paper on the programme was then presented, entitled "Free Engineering," by Perry West and George W. Knight. This paper was read by Prof. J. D. Hoffman.

In discussing this paper Mr. J. H. Davis called attention to the fact that vacuum heating systems were for a long time not acceptable to heating engineers until the manufacturers guaranteed their plants. The same condition existed with respect to blower manufacturers.

Topical discussion then followed on the "operation and care of heating and ventilating apparatus" and on the "reluctance to divulge alleged secrets in relation to engineering practice."

Mr. Normal L. Patterson stated that in Chicago operating engineers were under the local civil service and that their efficiency in handling their apparatus was one of the principal points considered in their promotion. Cook County, he said, has instituted a similar system of civil service.

AFTERNOON SESSION, JUNE 6

The afternoon session was opened with the reading of a paper by Paul P. Bird on "Some Phases of Smoke Prevention." This was followed by a much-discussed paper by Frank L. Busey, of the University of Illinois Experiment Station, on "New Basis for Rating House Heating Boilers and Furnaces." (Mr. Busey's paper is published on another page of this issue.) A third paper read at this session was presented by A. W.

Glessner, entitled, "Tests on Double Wall Warm Air Furnace Piping."

The remainder of the session was taken up with topical discussion.

MORNING SESSION, JULY 7

Friday morning's programme included a paper by Samuel R. Lewis on "Heating and Ventilating High School Buildings in Decatur, Ill.," and a paper by D. M. Quay, on "Ventilation of the Macy Store, New York." A paper by W. Thorn was also read on "Street Car Ventilation." Numerous given topics were also discussed, the meeting coming to final adjournment at noon.

The following were present and registered:

MEMBERS AND GUESTS

Reginald Pelham Bolton, New York.
John R. Allen, Ann Arbor, Mich.
W. W. Macon, Brooklyn, N. Y.
Jas. H. Davis, Chicago.
A. S. Armagnac, New York.
W. M. Mackay, New York.
W. H. Johnson, Indianapolis.
J. D. Hoffman, Lafayette, Ind.
Emmons Collins, Chicago.
B. F. Raber, Lafayette, Ind.
Thomas Tait, Moline, Ill.
Dr. E. von Rehm, Chicago.
L. C. Soule, Chicago.
Frank L. Busey, Chicago.
John D. Small, Chicago.
N. L. Patterson, Chicago.
A. W. Glessner, Chicago.
Ben Cones, Indianapolis.
John F. Hale, Camden, N. J.
Wm. Bronaugh, Chicago.
S. R. Lewis, Chicago.
William Ritchie, New York.
A. C. Burdick, Seattle, Wash.
O. Monett, Chicago.
Chas. E. Warsop, Chicago.
A. G. Cripps, Akron, O.
George Mehring, Chicago.
Eugene Bradley, St. Louis.
Geo. H. Kauffman, Chicago.
Robert L. Gifford, Chicago.
F. Van Inwagen, Chicago.
R. B. Hayward, Chicago.
B. Natkin, Chicago.
Harry de Joannis, Chicago.
Geo. W. Wood, Chicago.
J. P. Morley, Chicago.
Theodore Weinshank, Indianapolis.
Mrs. Theodore Weinshank, Indianapolis.
Miss Anna Weinshank, Indianapolis.
Mrs. W. Adams, Indianapolis.
J. H. Martin, Jr., New York.
E. Sugerman, New York.
A. N. Goff, Chicago.
H. R. Putland, Chicago.
Frank M. Bailey, Chicago.
J. F. Wing, Chicago.
H. Ehrlich, Chicago.
Geo. H. Kirk, Chicago.
J. M. Stannard, Chicago.
Henry H. Lee, Springfield, Mass.
Albert Scheible, Chicago.
Daniel Stern, Chicago.
Paul P. Bird, Chicago.
H. B. McLelland, Chicago.
Geo. M. Tait, Chicago.
Mrs. Geo. M. Tait, Chicago.
Mrs. Thomas Tait, Moline, Ill.
Joseph G. Hayes, Indianapolis.
R. M. Stackhouse, Chicago.
G. G. R. Tratman, Chicago.
A. F. Sterrett, Chicago.
H. A. Miller, Chicago.
E. C. Carey, Chicago.
R. W. Hillman, Chicago.
B. T. Gifford, Chicago.
A. T. Clark, Chicago.
C. E. Wright, Chicago.
J. H. Kitchen, Kansas City, Mo.
Chas. F. Newport, Chicago.
H. Marell, Stockholm, Sweden.
F. S. Whitelaw, Chicago.
Mrs. Harry de Joannis, Chicago.
Miss de Joannis, Chicago.
Mrs. J. Seags, St. Louis.
E. B. Gordon, Jr., Chicago.
W. B. Graves, Chicago.
B. W. Brady, Chicago.
Fred. B. Orr, Chicago.
C. G. Rood, Chicago.
James E. Heg, Chicago.
A. S. Cameron, Chicago.
Wm. H. Chenoweth, Jr., Chicago.
G. M. Proudfoot, Chicago.
E. F. Capron, Chicago.
R. H. Kuss, Chicago.
R. L. Eddy, Chicago.
A. H. Schroth, Chicago.
W. A. Cameron, Chicago.
J. P. Dugger, Chicago.
M. F. Moore, Kewanee, Ill.
H. E. Pursell, Kewanee, Ill.
Miss D. Hayes, Indianapolis.
E. N. Murphy, Chicago.
R. Collamore, Detroit, Mich.
R. G. Rosenbach, Chicago.
Ben Nelson, Chicago.
Victor Larsen, Chicago.
Francis H. McGuire, Rockford, Ill.
H. W. Ellis, Chicago.
H. R. Dillon, Chicago.
A. W. Boylston, Chicago.
L. M. Berwin, Chicago.
Wm. M. Scudder, Chicago.
Mrs. Geo. H. Kirk, Chicago.
Dr. W. F. Colbert, Philadelphia.
M. F. Thomas, Chicago.
Chas. K. Foster, Chicago.

NEW MEMBERS ELECTED

P. A. Bates, consulting engineer, 2 Rector street, New York.

William H. Chenoweth, Jr., Warren Webster Co., Chicago.

S. F. Gardner, Standard Engineering Co., Washington, D. C.

Joseph Graham, Editor *Engineering Review*, New York.

G. T. Hill, General Fire Extinguisher Co., Warren, O.

E. C. Hinkle, President, Atlantic Heating and Engineering Co., Trenton, N. J.

P. A. Hoffman, B. F. Sturtevant Co., New York.

C. R. Honiball, C. R. Honiball Co., Liverpool, England.

N. K. Howard, Consulting Engineer, with Geo. H. Wentz, Lincoln, Neb.

W. P. Klobukowski, 71, Jerozolimska, Warsaw, Poland.

J. I. Lyle, General Manager, Carrier Air Conditioning Co., New York.

F. A. Miller, Supervising Architect's Office, Treasury Department, Washington, D. C.

M. P. Miller, Warren Webster & Co., Camden, N. J.

W. R. Murphy, General Manager, American Heating and Ventilating Co., Richmond, Va.

O. E. Polglase, Westinghouse, Church, Kerr & Co., New York.

C. L. Reeder, consulting engineer, Baltimore, Md.

Arthur Ritter, American Blower Co., New York.

H. C. Russell, Supervising Architect's Office, Treasury Department, Washington, D. C.

W. T. Smallman, treasurer, Isaac Coffin & Co., Boston.

Robert Thomson, Thomson & Homer, Winnipeg, Man.

C. W. Williams, Williams & Cole, Boston, Mass.

H. L. Williams, President, American Warming and Ventilating Co., Pittsburg.

ASSOCIATES

W. G. Culbert, McCrum-Howell Co., Philadelphia, Pa.
Joseph McCusker, Portland, Ore.
C. H. Spiehler, heating engineer, Dayton Lighting Co., Dayton, O.
E. J. Treat, Autoforce Ventilating System, New York.

Social Features of the Meeting

True to their reputation the members of the Illinois Chapter of the Heating Engineers' Society filled every spare moment of the meeting with a delightful series of diversions. The entertainment programme was in the immediate charge of Samuel R. Lewis, W. L. Bronaugh and L. C. Soule, of the Illinois Chapter.

Touring cars were at the disposal of the members and guests throughout the meeting; a considerable number arrived on the evening preceding the opening session in time to enjoy a spin, which was a most grateful relief from the sweltering weather conditions prevailing at the time.

While the first day's session was in progress the visiting ladies were taken to the Marshall Field department store. Here tea was served with the compliments of the Illinois Chapter. In the evening the entire party dined on the roof garden of the La Salle Hotel, where the pleasures were prolonged to a late hour.

The following afternoon, after the close of the morning session, automobiles were in waiting to take the party through Chicago's twenty-five miles of parks and boulevards. This trip was made under ideal weather conditions and was a treat that will not soon be forgotten by those who were so fortunate as to be present. The party afterwards visited the plant of the Sears-Roebuck Co.

A very full day was capped with a moonlight sail on Lake Michigan on the steel steamer, "Theodore Roosevelt." Nearly three hours were spent on the lake, the steamer taking a course of some ten miles towards the center of the lake and back.

Although the meeting had come to final adjournment, many stayed over until Saturday to join the parties that inspected the mechanical equipments of the La Salle and Blackstone Hotels. Before the meeting adjourned, however, a cordial vote of thanks was extended to the Illinois Chapter and its members for their bounteous hospitality.

$8,200,000 Federal Heater Company

Announcement has been made of the formation of the Federal Heater Co., with a capital of $8,200,000. The company is a merger of seven different concerns engaged in the manufacture of various kinds of heating apparatus. The headquarters will be in Chicago.

The constituent companies of the new merger are the International Heater Co., Utica, N. Y.; the Peck-Williamson Co., Cincinnati, O.; the L. J. Mueller Furnace Co., Milwaukee, Wis; the Twentieth Centuhy Heating and Ventilating Co., Akron, O.; the Henry & Scheible Co., Cleveland, O.; the Quaker Mfg. Co., Chicago, and the Ideal Furnace Co., Detroit, Mich.

The combined companies produce steam and hot water boilers for heating purposes, designed for both coal and gas, warm air furnaces and tank heaters. As a result of the consolidation the Federal Heater Co. will have an annual output of 40,000 heaters.

The capital stock is divided into $4,000,000 7 per cent. cumulative preferred and $4,200,000 common. Most of the capital stock has been taken by plant owners in payment for their properties. A relatively small amount of cash is being used in the merger. About $1,500,000 of the preferred stock will be offered simultaneously in Chicago, New York, Cincinnati and Detroit. This will be sold at par with a bonus of 10 per cent. in common stock.

A. W. Williamson, president of the Peck-Williamson Co., will be president of the new corporation; L. J. Mueller, Jr., and John Kerch will be vice-presidents. The secretary will be D. M. Compton and the treasurer, F. H. Moore, of the International Heater Co.

The company starts without any bonds or debts. It is announced that the earnings of the constituent companies in 1910 were equal to $450,000 net. For 1911 the earnings are estimated to be $550,000. After deducting $280,000 for the preferred dividend there would remain $270,000; applicable to the common stock, being 6.4 per cent. of that issue.

The following statement of assets and liabilities appears in the prospectus:

ASSETS

Plants, etc.		$6,310,693
Merchandise (not including that contracted for to be valued by inventory)	$485,848	
Accounts receivable (not including those to be retained by certain companies)	443,458	
		929,306
Cash acquired with assets of Companies	$60,000	
Cash to be paid in from sales of stock for additional operating capital	900,000	
		960,000
Total		$8,200,000

LIABILITIES

Preferred stock	$4,000,000
Common stock	4,200,000
Total	$8,200,000

$800,000 common stock is retained in the treasury to provide for increase of business.

James D. Hoffman, professor of mechanical engineering at Purdue University, Lafayette, Ind., has been appointed head of the engineering department of the University of Nebraska at Lincoln, Neb. Professor Hoffman is well known in the heating and ventilating profession and is a past president of the American Society of Heating and Ventilating Engineers. He is receiving congratulations from his many friends on his call to the larger work he will undertake at the University of Nebraska.

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CANADIAN Society of Sanitary and Heating Engineers is the new title that has been adopted by the National Association of Master Plumbers and Steam Fitters of Canada. We have already referred to what seems to us an anomaly in thus characterizing an organization made up in such large part of master plumbers. We can think of no more pungent comment, however, than that voiced by the *Plumber and Steamfitter*, of Canada, in its statement that "on Wednesday morning at ten o'clock one hundred master plumbers entered the convention hall. At 12:30 one hundred sanitary and heating engineers left the hall."

NOW that the proposed plan to enlarge New York's subway is assuming definite shape the matter of its ventilation is being taken up by interested citizens with a view of preventing, if possible, the serious air conditions, both as to high temperature and odors, that prevail in the present subway. It may not be generally known that the extensions as planned embrace more mileage than the whole of the present system so that the subject assumes an importance equal to, if not greater than, that of the ventilation of the original subway itself. Bitter experience, moreover, has taught the thousands of patrons that now is the time to secure favorable action rather than after the new subways are built. For years the public has been treated to the makeshift and futile efforts to procure cool, or, at least, fresh air in the present tubes, although at the present time the subway is noticeably warmer and more malodorous than at any previous time in its history. The most sensible suggestion for securing adequate ventilation in the new subway, and one which has already won the endorsement of part of the public press, has been proposed by Albert E. Henschel, formerly secretary of the Greater New York Charter Commission. Mr. Henschel's proposition is the appointment, by the city's Board of Estimate and Apportionment, of a commission of experts in sanitary science and ventilation to advise the board on this question.

IT IS a pleasure to note that Ohio has recognized the importance of compulsory ventilation of buildings to the extent that its new building code provides for the mechanical ventilation of its theatres and other places of assembly. We shall publish in the August issue that portion of the code bearing on ventilation.

Central Station Heating

4.—OPERATION

By Byron T. Gifford

(Previous articles in this series: "Pipe Line Losses," April, 1911; "Rates," May, 1911; "'Ready to Serve' or 'Maximum Demand' Rate," June, 1911.)

Pressure Required at the Station

This pressure is dependent upon the pipe line sizes, the insulation and the grade of the pipe line in steam heating plants. In hot water plants it is dependent upon the pipe line sizes, the insulation, and the elevation of the heating station relative to the buildings being served.

After a plant is in operation it is an easy matter to determine the drop in pressure from one point to another and under actual operating conditions. Having determined the point on the line where the greatest drop in pressure occurs, we can determine the pressure necessary to carry at the station in order to have the required pressure at the weakest point. So much is very easy, but to determine whether or not excess pressure is being carried in order to create the necessary pressure at the weak point is quite another problem and is not so easy to determine.

Causes That Demand Excess Pressure in Steam Heating Mains

Insufficient pipe sizes is one of the most common causes of bad pressure conditions. Often a given line has developed more business than it can handle economically and excessive pressure is required to make this line carry sufficient steam to suppy its connected load.

Improper line drainage also causes a bad pressure condition. For example, a line not properly graded, with a pocket in it, will cause no end of trouble. The pocket will fill with condensation and, even though a water hammer does not develop, the free area of the pipe is reduced, the friction increased and, consequently, the pressure at the station must be increased to compensate for this additional friction loss. The condition is often found in service lines and should be guarded against and, if possible, located and remedied by means of regrading the line or by installing additional bleeder connections.

Causes That Demand Excess Pressure in Hot Water Heating

In central station hot water heating we are not troubled so much with pockets as in steam, but the writer believes them as serious in one case as in the other. Air pockets do the damage in hot water heating and every high point should be vented and kept free from air. In this case the

pipe, or a part of it, fills with air and the flow of water is restricted, requiring a greater pressure in order to give proper circulation.

Insufficient pipe sizes is also a cause of excess pressures being necessary. This defect is often caused by the territory out-growing the pipe line.

To determine whether excess pressures are being carried, refer to your pipe capacity tables and find out if the conditions you are experiencing in your pipe line conform to the table. If not, look for the trouble.

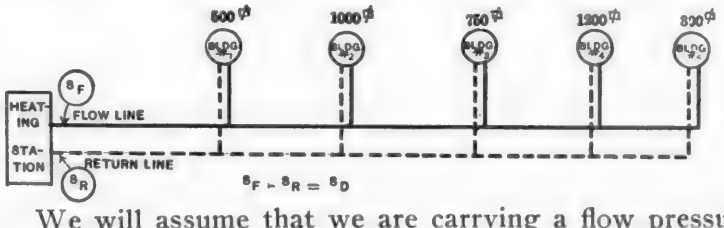
If your operating and test observations show that your pipe line is not demanding an excessive pressure, you can then carry the lowest possible pressure that will give you 1 lb. (if steam) and 1 lb. difference in pressure (if water) at the weakest point on the line.

In hot water heating, as already stated, the difference in pressure is what you need, the circulating pressure or, as it is often called, the differential pressure. For example, the pressure on the flow line is 40 lbs. and on the return line 30 lbs., thereby making the differential pressure 10 lbs. There must be at least 1 lb. differential pressure at the entrance of the building and each and every radiator must be full of water in order to heat a building properly. Therefore, the return pressure at the building should be sufficient to raise the water to the top of the building and the flow pressure should be at least 1 lb. more.

Locate the weakest point in this connection and be guided accordingly. As a rule, the weakest point will be at the end of some long lateral.

Pumpage in Hot Water Heating

One of the most important points in hot water heating is the amount of water pumped per square foot of radiation, per unit of time. Excessive pumpage means a waste of power and is a sure sign of poor operating conditions. To remedy this trouble it is necessary to regulate the amount of water passing through each building. To explain more fully this point we will study the following drawing.



We will assume that we are carrying a flow pressure at the station (SF) of 45 lbs. and a return pressure (SR) of 30 lbs. giving us a differential pressure (SD) of 15 lbs. at the station. Under these conditions we find by test that our pressure conditions would be as follows:

Position	Flow Pressure, pounds per square inch	Return Pressure, pounds per square inch	Differential Pressure, pounds per square inch
Station	45	30	15
Building No. 1	44	31	13
Building No. 2	42.5	32.5	10
Building No. 3	41	34	7
Building No. 4	39.5	35.5	4
Building No. 5	38	37	1

Now the problem to be solved is, whether or not we have excess pumpage. We know that under the conditions we have as low a differential (SD) as we possibly can have and still have one pound difference at Building No. 5. If we are pumping too much water it is going through the four jobs nearest the station.

In order to determine this it is necessary to measure the amount of water flowing through each job. This can be easily done by means of a hot water disc meter. The result will be sufficiently accurate to answer our purpose.

Pumpage Necessary

The amount of water necessary to pump per square foot of radiation per hour seems to be an unsettled question. One thing is certain; the water carries the heat and 1 lb. of water will deliver as many heat units as it loses in degrees Fahrenheit going through the radiation.

If the water loses 20° F, it will emit 20 B.T.U. per pound. If the radiation is figured so as to give off 180 B.T.U. per square foot per hour at zero, outside temperature, it would require 9 lbs. of water per square foot per hour. If we regulate the flow of water through each square foot of radiation so as to omit 30 B.T.U. per pound, it would require 6 lbs. of water per square foot of radiation per hour, at zero outside.

When the temperature outside is higher, the temperature of the water will be lower and consequently the water will not lose as much heat per pound. The amount of water pumped can be reduced some, but not to any considerable extent, unless temperature regulation of some kind is used in the buildings.

Regulating the Flow of Water

We will take it for granted that we need 6 lbs. of water per square foot of radiation per hour at Building No. 1. This building has 500 sq. ft. of radiation and consequently would need 3,000 lbs. of water per hour. The differential pressure at Building No. 1 is 13 lbs. The opening necessary to supply this amount of water at this differential pressure is a 5-16-in. hole.

Building No. 2, with 1,000 sq. ft. and 10 lbs. differential pressure, would require a 13-32-in. hole.

Building No. 3, with 750 sq. ft. and 7 lbs. differential pressure, would require a 13-32-in. hole.

Building No. 4, with 1,200 sq. ft. and 4 lbs. differential pressure, would require a 5-16-in. hole.

Building No. 5, with 300 sq. ft. and 1 lb. differential pressure, would require a 13-32-in. hole.

These chokes or retarders should be placed in the return line just before it leaves the building, or on the return of each belt. The placing of these requires judgment and experience.

The total area of the chokes is found to be:

Building No. 1	5/16 in.
Building No. 2	13/32 in.
Building No. 3	13/32 in.
Building No. 4	5/16 in.
Building No. 5	13/32 in.
	1-27/32 in.

The service lines run to these buildings should be not less than 1¼-in. in diameter, even though that size is too large, for at some future time the amount of radiation might be increased and the large service line will be sufficiently large to take care of the additional load.

With this method of regulation, perfect control cannot be accomplished, but a great benefit can be derived by using it.

A number of flow controlling valves have been devised and are more or less valuable to the operating man. The cost of these valves is the only thing that stops their universal adoption. It costs comparatively little to regulate with the chokes or retarders and, for that reason, this method is much more popular. The author has used a cast-iron choke, with a hole drilled through it, and has found it to be very well adapted to this use. It is noiseless and easily made.

The automatic flow controlling valve has the advantage by being self-adjusting, while the choke system is fixed for one condition. For example, assume that an 800 sq. ft. job is connected to the system shown before, between Buildings No. 1 and No. 2. The connecting of this job will affect the pressure necessary to carry at the station and will affect the size of the choke in Building No. 1. It would have to be just a little smaller, because, owing to the necessity of pumping more water, a larger differential pressure is necessary and, consequently, more water will pass through Building No. 1 than is necessary, unless the choke is made smaller. If the additional building is con-

nected and the pumpage is not increased, the balance of the system will be affected by not getting sufficient water.

In a case like the above, the flow controlling valve would adjust this condition automatically, because it allows only a certain amount of water to circulate through each building, no matter how much too great the differential pressure may be. On the other hand, disc or choke control has a slight advantage over the automatic valve control in one way. In choke control the pumpage can be momentarily increased on the whole system whenever it is advantageous to do so, which is sometimes the case, especially in rapidly falling temperature. By increasing the pumpage we increase the number of B.T.U. given off by each square foot of radiation, because the number of B.T.U. emitted is proportional to the difference between the room temperature and the average temperature of the radiator.

The faster the water circulates through the radiator the less heat each pound of water will emit and the less each pound of water emits, the hotter is the water leaving the radiator and, consequently, the higher the average temperature of the radiator, which, of course, means that each square foot of radiation will emit more heat per unit of time. This is an advantage when a severe and rapid drop in temperature is experienced. This is especially true in systems controlled by thermostats, where, by increasing the heat emission, all thermostats, almost to the shutting off place, will shut off and decrease the load on the plant temporarily and materially help in raising the temperature of the circulating water.

(Mr. Gifford's next article will appear in the August issue.)

Color Scheme for Identification of Power House Piping

A definite plan for identifying power house piping by means of distinguishing colors is contained in a report recently submitted to the American Society of Mechanical Engineers by a committee on the subject. This matter, it will be remembered, was first prominently agitated by the late William H. Bryan, of St. Louis, several years ago, and the present recommendations are the result of several committees' efforts in this direction. Following are the recommendations in detail:

In the main engine rooms of plants which are well lighted, and where the functions of the exposed pipes are obvious, all pipes shall be painted to conform to the color scheme of the room; and if it is desirable to distinguish pipe systems, colors shall be used only on flanges and on valve-fitting flanges.

In all other parts of the plant, such as boiler house, basements, etc., all pipes (exclusive of valves, flanges and fittings), except the fire system, shall be painted black, or some other single, plain, durable, inexpensive color.

All fire lines (suction and discharge), including pipe lines, valve flanges and fittings, shall be painted red throughout.

The edges of all flanges, fittings or valve flanges on pipe lines larger than 4 inches inside diameter, and the entire fittings, valves and flanges on lines 4 in. inside diameter and smaller, shall be painted the following distinguishing colors, numbered 1 to 12, inclusive:

DISTINGUISHING COLORS TO BE USED ON VALVES, FLANGES AND FITTINGS ONLY

Steam Division: High pressure—white. Exhaust system—buff.

Water Division: Fresh water, low pressure—blue. Fresh water, high pres-

sure boiler feed lines—blue and white. Salt water piping—green.
Oil Division: Delivery and discnarge—brass or bronze yellow.
Pneumatic Division: All pipes—gray.
Gas Division: City lighting service—aluminum. Gas engine service—black, red flanges.
Fuel Oil Division: All piping—black.
Refrigerating System: White and green stripes alternately on flanges and fittings, body of pipe being black.
Electric Lines and Feeders: Black and red stripes alternately on flanges and fittings, body of pipe being black.

The committee is composed of H. G. Stott, chairman; F. R. Hutton, I. E. Moultrop, H. P. Norton and J. T. Whittlesey.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CENTRAL STATION HEATING

Exhaust Steam Heating as Developed by a Large Central Lighting Station. E. Darrow. Illustrated explanation of the system of central station supply of heat used by a company in Indianapolis, Ind. 1200 words. Elec. Wld.—April 6, 1911. 20c.

HEATING OF RESIDENCES

Heating of Residences. D. D. Kimball. Discusses the importance of ventilation in the home, the control of temperature, humidity, heating system, etc., 2500 words. Ins. Engng.—March, 1911. 40c.

SHOP VENTILATION

Dust Collecting Appliance in Cotton Mills. Illustrates and describes improvements introduced for stripping and extraction of dust of a carding engine, and protection from accidents. 2500 words. Engng.—April 14, 1911. 40c.

Ohio's New Building Code Regulates the Heating and Ventilation of Theatres

Included in Ohio's new building code, which recently became a law, are special provisions regarding the heating and ventilation of theatres. The code is designed to regulate the construction, repair and alterations and additions to public buildings and other buildings in the state. Its provisions are to be enforced by the state fire marshal, the chief inspector of workshops and factories and the state board of health.

According to a ruling of Attorney-General T. H. Hogan, the new code does not apply in municipalities which now have sufficiently stringent building codes in force.

In the construction of theatres the code provides that furnaces, hot water heating boilers and low-pressure steam heating apparatus, breeching, fuel room and firing room must be enclosed in an approved fireproof heater room and all openings in same are to be covered by approved self-closing fire doors. The heating system must of sufficient capacity to heat all parts of the building to a temperature of 65 degrees Fah.

The ventilation requirements are especially interesting. The system of ventilation must provide for a change of air in all parts of the building at least six times each hour. All assembly halls and theatre auditoriums must be supplied with fresh warmed air to the amount of 1200 cu. ft. per hour for each person. The system may be either a gravity or mechanical furnace system, gravity indirect steam or hot water, or a mechanical indirect steam or hot water system. Fresh air must be taken from outside of the building and the recirculation of vitiated air is forbidden. No floor register for heating or ventilating shall be placed in any aisle or passageway.

Legal Decisions

Estoppel by Decree from Denial of Waste of Heating Company's Gas

In a suit by a heating company to restrain a gas company from wasting gas derived from a field from which the heating company obtained its natural gas, by the operation of a lampblack factory, it was adjudged that the gas company did operate such factory and it was enjoined from wasting the gas in such operation. In a subsequent action by the heating company to recover damages alleged to have been sustained by the heating company from such waste of gas it was held that the gas company was estopped by the decree in the prior suit from thereafter litigating the fact that they operated the factory.—Louisville Gas Co. vs. Kentucky Heating Co., Kentucky Court of Appeals, 134 S. W. 205.

Rescission of Contract of Sale by Seller's Actions

A seller of water heaters made contracts with a large number of retailers, each order containing the condition, "These goods shipped at this price only upon condition that number sufficient to obtain quantity discount is purchased in city." Before the contract was executed the parties mutually agreed that the entire lot of heaters should be delivered to

a heating company, which would distribute them and receive payment. After delivery the seller wrote to the buyers telling them to pay the heating company. In an action by the seller against one of the purchasers it was held that by the acts of the seller any indebtedness which might have accrued to him was released and there was a complete novation of the contract.—Michigan Stove Co. vs. A. H. Walker & Co., Iowa Supreme Court, N. W. 130.

No Liability of Heating and Ventilating Contractors' Surety Beyond Terms of Bond

A board of education contracted with an engineering company to install the heating and ventilating equipment of a public school building. A guaranty company become surety on the contractor's bond. The contractor did not perform his undertaking, but a corporation subsequently formed did so. No contract appeared between this corporation and the contractor or the board of education. A company furnished and installed the covering for the steam pipes, part of the heating apparatus, under a contract with the corporation alone. The corporation became insolvent and omitted to pay for the material and labor employed in the pipe covering. The company sued the surety on the bond of the original contractor. It was held that the company could not recover against the surety, because it did not appear that the material was furnished or the labor performed under a contract with, or at the instance or request of, the original contractors, whose conduct was assured by the surety, or with the board of education, which was authorized to complete any portion of the work not installed by the contractors.—Board of Education of City of St. Louis vs. United States Fidelity & Guaranty Co. (Missouri), 134 S. W. 18.

Federal Furnace League

At a special meeting of the executive committee of the Federal Furnace League, held in Philadelphia June 19, reports were received on the official testing of furnaces, and the work of the engineering department was reviewed and approved. The text and rules of the book, entitled "The Federal System of Heating and Ventilation" were reviewed and certain revisions were ordered, chiefly in the direction of simplification of the rules.

It is expected that the testing of the furnaces of the members will be completed, and that the Federal System book will be issued during the coming autumn. The furnace industry, it is stated, will then have a standard, authoritative system of installation, with the capacity ratings of the leading furnaces determined by actual tests of the apparatus. The league reports the enthusiastic support of its membership in the plan for establishing a standard system of installation and of capacity ratings.

The executive committee accepted the invitation of the National Association of Sheet Metal Contractors to attend the annual meeting of that organization at Omaha on August 8-11. The league will accordingly be represented at that meeting by its engineer, Dr. Wm. F. Colbert; its secretary, Wilson Ferguson, and by a delegation from its executive committee and membership.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

New York State Association

At the annual meeting of the New York State Association of Master Steam and Hot Water Fitters, held at the headquarters of the National Association, in New York, the following officers were elected for the ensuing year: President, Samuel Wright, Buffalo; vice-president, Edward F. Joy, Syracuse; secretary-treasurer, William H. Curtin, New York; sergeant-at-arms, William Scollay, New York; board of directors, Charles Geiger, Buffalo; Frank H. Falls, Rochester; Frank Leavery, Syracuse; William H. McKiever, New York; Ernest C. Seward, New York; Samuel Wright, Buffalo; Edward F. Joy, Syracuse; William H. Curtin, New York. Subsequently the board of directors elected Charles Geiger chairman and H. B. Gombers, New York, recording secretary.

Pennsylvania State Association

Following are the new officers of the Pennsylvania Association of Master Steam and Hot Water Fitters, elected at its fifteenth annual convention Pittsburg: President, William P. Thompson, Philadelphia; vice-president, P. F. Maginn, Pittsburg; secretary, M. G. Sellers, Philadelphia; treasurer, Harry G. Black, Philadelphia; sergeant-at-arms, John C. F. Trachsel, Philadelphia; executive committee, Joseph A. Langdon, Pittsburg; B. Harold Carpenter, Wilkes-Barre; Stewart A. Jellett, Philadelphia; John R. Flinn, Johnstown; C. Ed. Hantz, York.

Philadelphia Local Association

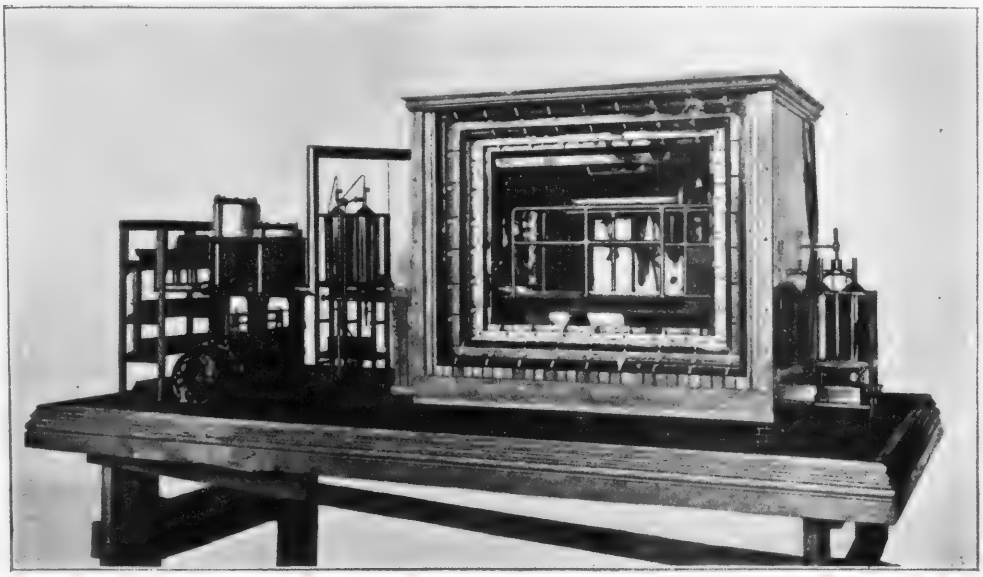
Following are the officers of the Philadelphia Master Fitters' Association elected at its recent annual meeting: President, Robert J. Hoben; vice-president, John L. Moyer; treasurer, Edw. R. Steinmetz; secretary, M. G. Sellers; executive committee, John L. Moyer, Stewart A. Jellett and William P. Thompson.

A Respiration Calorimeter for Animals

An apparatus that has been in use for some time by the Pennsylvania State College Institute of Animal Nutrition to determine the nutritive values of different animal foods offers many features of interest to the heating and ventilating engineer. It is a respiration calorimeter, similar in many respects to that used at Wesleyan University, in which men were the subjects tested. By means of the apparatus and its accessories it is possible to determine exactly, not only the amounts of digestible matter and potential energy contained in animal foods, but also the use which the organism makes of these. The experiments, which were made under the supervision of Dr. H. P. Armsby, director of the Pennsylvania Experiment Station, included chemical analyses of the feeding stuffs used and of the visible excreta, the determination of their heats of combustion, a determination of the gases given off in the respiration of the animal, and the amount of heat which the animal produces. The apparatus is large enough for experiments upon fully mature cattle.

While no figures are given regarding the effects on the air of the respiration of the animal, the air supply being 700 liters (17.64 cu. ft.) per minute, the details of construction of the calorimeter itself are important and valuable because the apparatus in its present form represents the solution of several problems in connection with the tests. As now arranged, the respiration calorimeter takes care of practically every condition, and is, therefore, a standard type of apparatus for use in this class of work, including respiration tests.

The general construction of the respiration chamber is shown in the accompanying illustration. The chamber is constructed of sheet copper, and measures 6 ft. by 10 ft, 4 in. and 8 ft. high. A platform 21 in. above the base of the chamber carries the stall in which the animal stands. Beneath the rear portion of this stall is a small chamber of sheet copper about 34 by 67 in., entirely shut off from the rest of the respiration chamber except for two holes through the platform, and having a separate air-tight door. Through one of the holes mentioned a rubber tube leads from the urine funnel to a receptacle of tinned copper; to the other hole is attached a large rubber duct covering the hindquarters of the animal, and underneath it is placed a galvanized iron box, tightly pressed against the lower side of the platform, to receive the droppings of the animal.



MODEL OF RESPIRATION CALORIMETER, SHOWING GENERAL PLAN AND DETAILS OF CONSTRUCTION

At the other end of the platform is the feed box. This is provided with an air-tight cover, which can be opened or closed by means of a lever operated from outside, and is also provided with an air-tight door. By lowering the cover the feed box can be entirely shut off from the chamber. The air-tight door can then be opened for the introduction of feed or the removal of residues, the door closed and the lid again lifted. The arrangement constitutes, in brief, an air lock. The water supply is introduced into a small drinking basin at the side of the feed box by means of a pipe carried through the calorimeter wall, the water

being weighed in and any excess removed by drawing the water in the pipe down to a fixed level.

The large door at the rear of the apparatus through which the animal enters and the two small doors giving access respectively to the feed box and excreta have heavy oak frames and are made tight by means of gaskets composed of rubber tubing, the doors being kept in place by means of pressure catches such as are frequently used on large refrigerators.

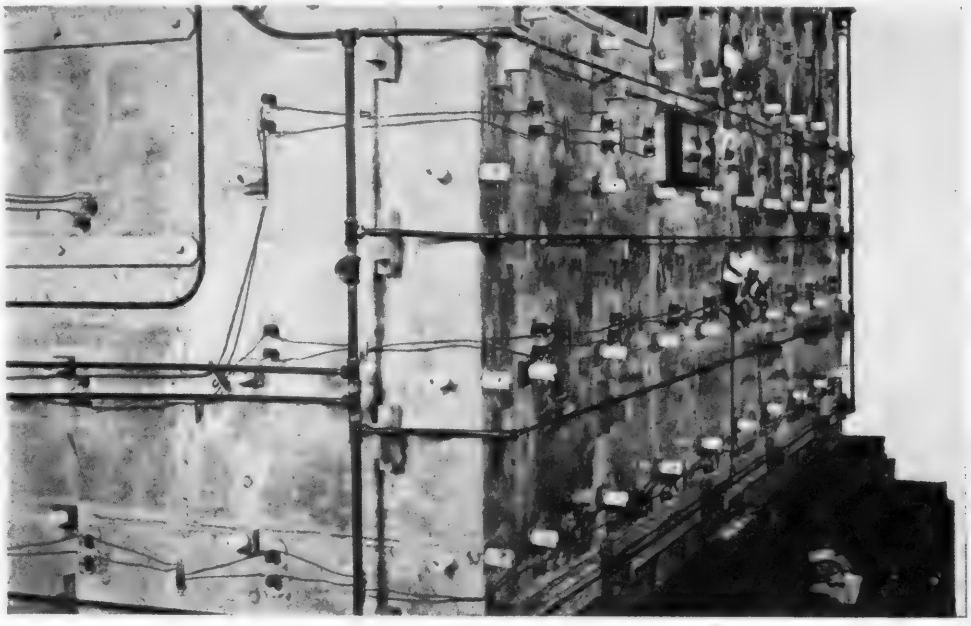
THE RESPIRATION APPARATUS

Through the chamber above described a current of outdoor air is aspirated by means of a special pump, the air first passing over the expansion coils of an ice machine, where most of its moisture is deposited as frost. At the point of entry to the chamber samples are taken alternately by one or the other of two large aspirators of constant flow at the rate of 200 liters in 12 hours. In these samples moisture and carbon dioxide are determined by passing them through U tubes containing sulphuric acid and soda lime.

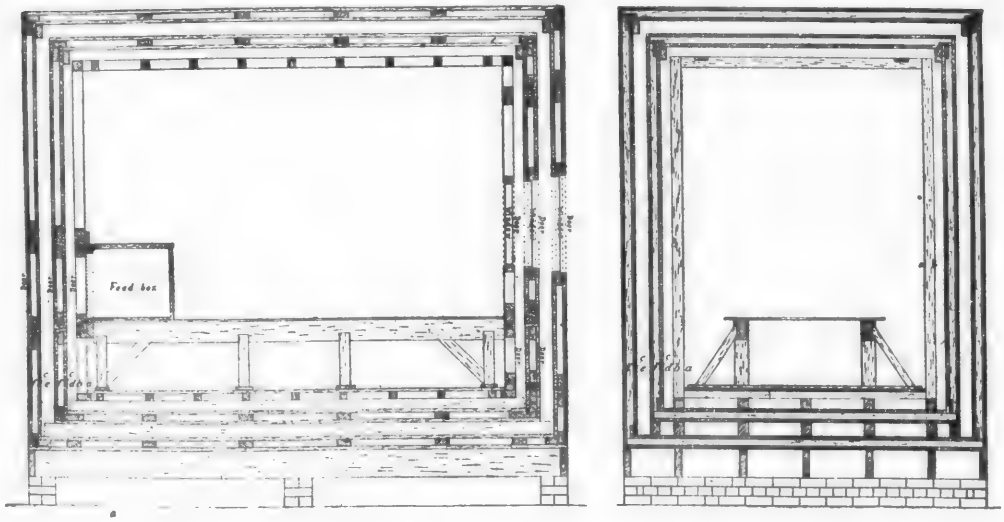
The air leaving the respiration chamber passes first through four large copper cans, standing in wells in a brine bath which is coiled to about —20° C. by means of the ice machine. In these cans the larger share of the moisture of the outcoming air condenses as frost and is subsequently weighed.

From the copper cans the air passes to the meter pump, which serves both to maintain the air current and to measure and sample it. The number of strokes as recorded by a revolution counter, with the corrections for temperature and pressure, gives the total volume of air passing through the apparatus, and the results of the analysis of the ingoing air, calculated upon this volume, give the weight of water and carbon dioxide carried into the apparatus by the current of air.

By means of a shunt valve connected with an ingenious train of gearing one stroke is delivered at regular intervals alternately through one or the other of two special outlets. The pump can be set to deliver thus one stroke in 200, one in 400, or one in 800. The two aliquot samples thus taken are conducted to two large pans having counterpoised rubber covers. From these pans each sample separately is aspirated by means of a subsidiary air pump, and after bubbling through concentrated sulphuric acid contained in a gas washing bottle passes through a set of six large U tubes (27 centimeters), the first two containing pumice stone saturated with sulphuric acid, the second two soda lime, and the last two pumice stone and sulphuric acid. The increase in weight of the flask and the first two tubes gives the amount of water and that of the remaining four tubes the amount of carbon dioxide contained in the samples, and these amounts, multiplied by the proper factor, give the total amounts contained in the outcoming air. Subtracting those contained in the ingoing air, determined as described,



ARRANGEMENT OF HEATING WIRES, COOLING PIPES, ETC., IN ANIMAL RESPIRATION CALORIMETER

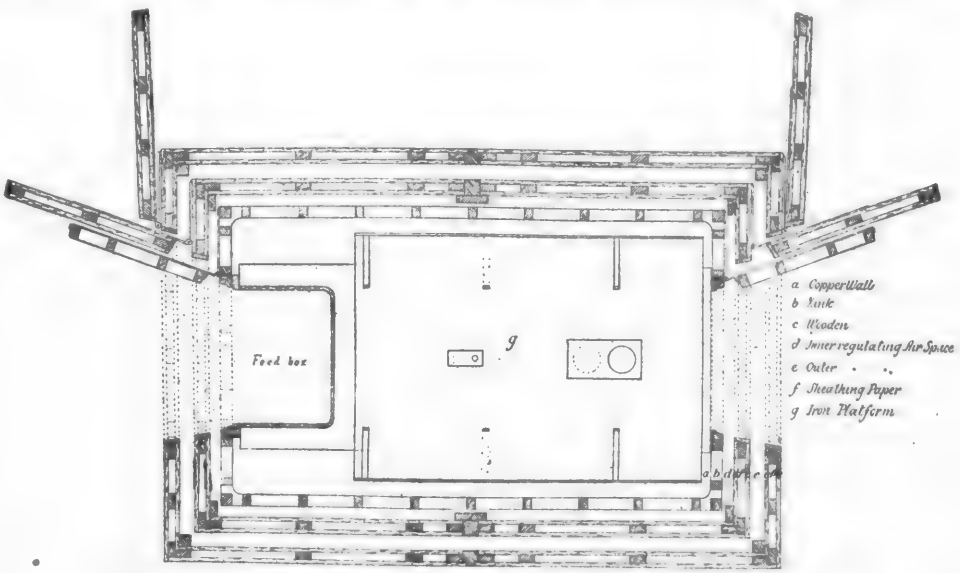


VERTICAL CROSS SECTION, ANIMAL RESPIRATION CALORIMETER

gives the amount added by the animal. Since 1906 the composition of the outcoming air has also been determined in samples taken by means of large aspirators (800 liters) of constant flow.

The arrangements for determining the heat given off by the animal are in all essentials like those of the Atwater-Rosa apparatus. The heat is absorbed by a current of cold water passing through copper pipes at the top of the respiration chamber, access of air to these pipes being regulated by means of shields which can be raised or lowered by the operator.

The respiration chamber proper of the apparatus is a metallic chamber of the dimensions stated above. Surrounding this, with an air space of 4 in. between is a double wooden wall, which in turn is surrounded by a second wall and air space of 4 in. The walls of the respiration chamber proper are double, the inner of copper and the outer of zinc, with a 3-in. dead air space between, and through these walls are distributed some 600 iron German-silver couples connected in series with a reflecting galvanometer and serving to indicate any difference in temperature between the inner (copper) and outer (zinc) surface. Any such difference is rectified and the walls of the chamber maintained adiabatic by heating or cooling the air space surrounding the zinc wall—the former by means of an electric current through resistance wires and the latter by circulating cold water



HORIZONTAL CROSS SECTION, ANIMAL RESPIRATION CALORIMETER

through brass pipes. The double wooden wall surrounding the metallic chamber also contains a smaller number of iron German-silver couples, and is in its turn kept nearly adiabatic by regulating the temperature of the second air space. By means of very similar devices, the temperature of the ingoing air is maintained the same as that of the outcoming air.

The temperature of the interior of the apparatus is measured by means of a series of copper resistance thermometers connected to a slide-wire Wheatstone bridge, and also by means of two mercurial thermometers. By raising or lowering the shields or varying the flow of water through the absorbers, the rate at which heat is removed through the water current may be so regulated as to keep the temperature of the interior constant within very small limits, while the slight variations are made to balance each other in the course of an experiment, so that there is practically no capacity correction. Under these conditions all the heat evolved by the animal must leave the apparatus either as sensible heat in the water current or as the latent heat of water vapor.

Largest Peat Machine in the Country

A peat machine with a daily excavating capacity of 2,500 tons per working day of two shifts, or about 310 tons of fuel ready for the market, allowing for the proper moisture content, has been built by Peat Industries, Ltd., of Montreal, Can., and is illustrated herewith. Peat Industries, Ltd., has lately been formed under the auspices of the railway builder and mine owner, M. J. O'Brien, who is the president of the company, and L. B. Lincoln, vice-president and managing director.

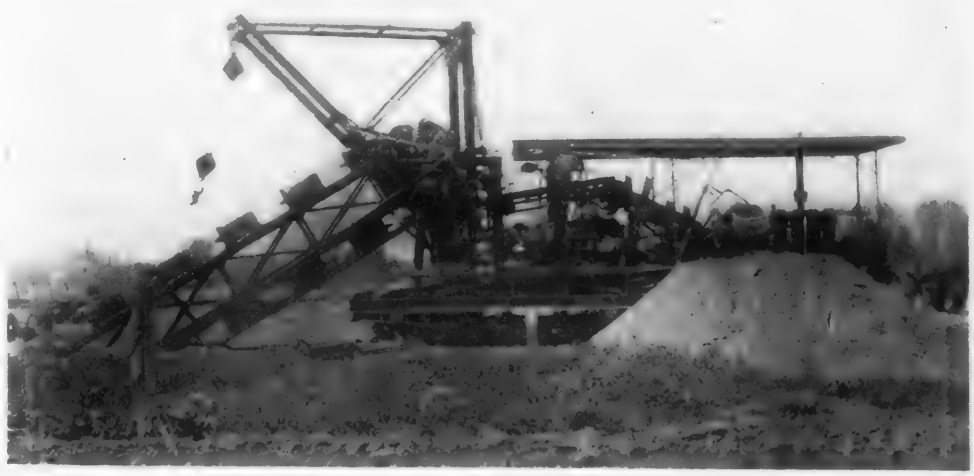
NEW DEVICES

A New Solder in Paste Form

Solderall, a new kind of iron solder, in the form of paste in a collapsible tube, has lately been placed on the market by the H. W. Johns-Manville Co., New York. It is put up in a manner similar to the familiar tube of tooth paste. In utilizing this new form of solder the surface of the pipe is first scraped with a knife, after which the paste may be squeezed from the tube onto the scraped surface, and a match, candle or torch applied. When the paste becomes hot it fuses and solders in the same manner as the old style soldering stick. Solderall may be obtained from any of the company's branch houses in various parts of the country. The company reports that it has already met with wide approval, especially on account of its convenience, cleanliness and economy.

A New Underground Pipe Covering

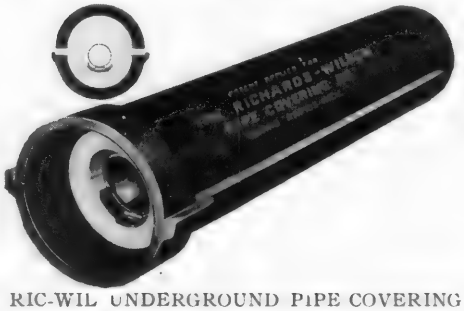
A new form of pipe covering is known as Ric-wil cement, which is the material used to insulate the Ric-wil vitrified tile casing shown in the accompanying illustrations. This covering, it is stated, has the highest efficiency of any known heat-insulating material. It has also proved a powerful non-conductor of electricity as well as of heat. In use it has been found to be not susceptible to disintegration or loss of efficiency from moisture, and the sectional covering made from this cement does not change its form or



LARGEST PORTABLE PEAT MACHINE IN THE COUNTRY

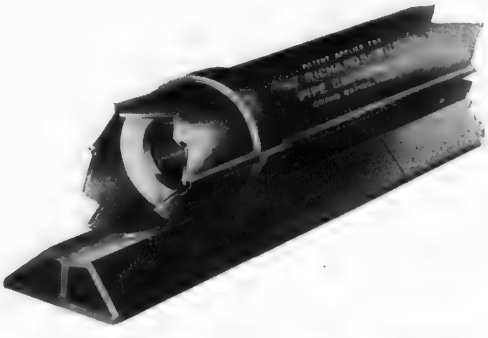
lose its power after repeated submersions in water.

Recent tests on this form of pipe cov-



RIC-WIL UNDERGROUND PIPE COVERING

ering are to the effect that there is practically no difference between the covering when used with or without an air space between the covering and the pipe, although it is probable that details of construction can be changed slightly to

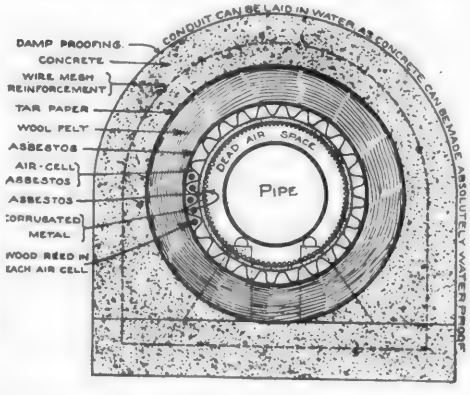


RIC-WIL UNDERGROUND PIPE COVERING, WITH BASE DRAIN

make the air space more efficient. The insulation tests showed that this type of covering is from 7.45 to 8.7 times as effective as the bare or uncovered pipes in preventing condensation of steam. An interesting result of the test was the discovery that with the Ric-wil covering the higher the steam pressure and steam temperature, the better the efficiency of the covering. The Ric-wil pipe covering is made by the Richards-Wilson Pipe Covering Co., Grand Rapids, Mich., and is sold through the Central Station Steam Co., Detroit, Mich.

Tyler Pipe Conduit and Tunnel Construction

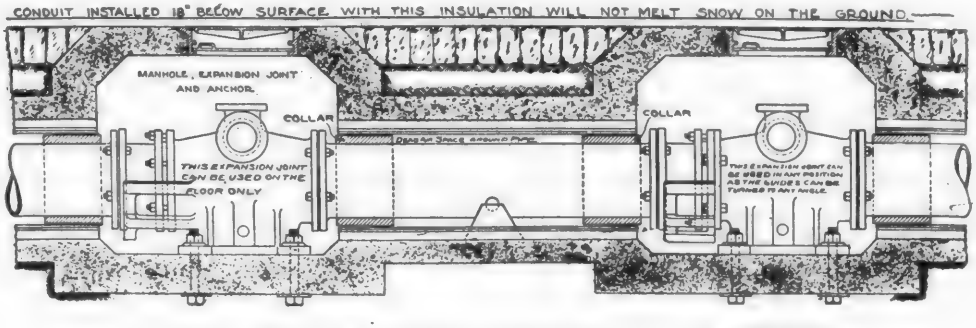
A number of interesting devices are included in the steam and hot water specialties lately placed on the market by E. B. Tyler, 301 House Bldg., Pittsburg, Pa., and in the Tyler patent system of underground conduit and tunnel construction. The accompanying illustrations show this type of pipe conduit, as well as typical views of the Tyler tunnel



TYLER PATENTED PIPE CONDUIT, SHOWING DETAILS OF CONSTRUCTION

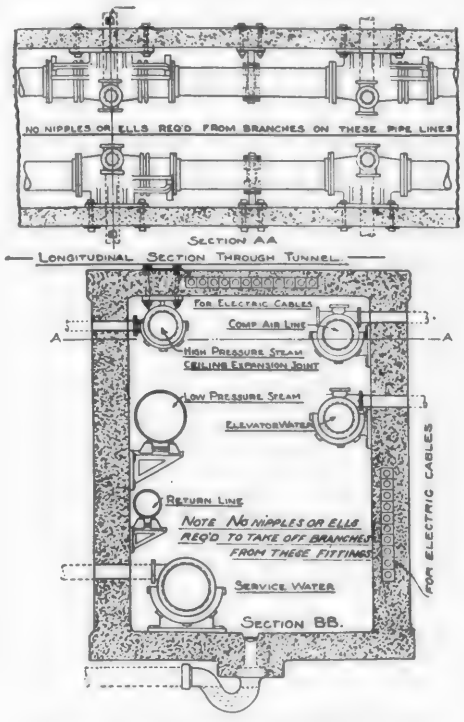
construction. The conduit is equipped with dirt-proof, ball-bearing pipe supports, while it is so built that the asbestos does not touch the pipe. It is stated that asbestos or magnesia has been found to fit pipes, steel or iron where it is used in contact with underground steam or hot water mains. In the tunnel construction use is made of the Tyler pipe support, designed to economize space.

The longitudinal sectional view of the conduit as installed shows the Tyler anchor and expansion joints, which are made with either side or top outlets, as required. They also have a pocket for removing the condensation. Emphasis


CONDUIT INSTALLED 18" BELOW SURFACE WITH THIS INSULATION WILL NOT MELT SNOW ON THE GROUND
MANHOLE, EXPANSION JOINT AND ANCHOR
COLLAR
COLLAR
THIS EXPANSION JOINT CAN BE USED ON THE FLOOR ONLY

TYPICAL SECTION OF TYLER UNDERGROUND PIPE CONDUIT

is laid on the fact that these fittings require no nipple or ells from which to take a branch, thus saving labor as well as head room in a tunnel or manhole.



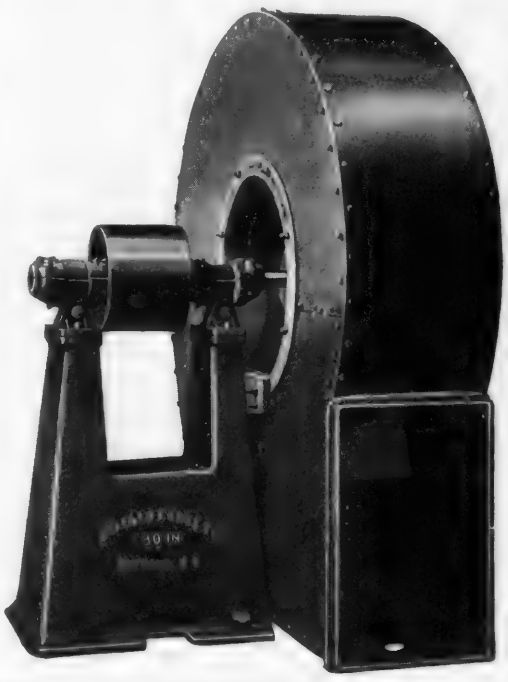
TYLER PIPE TUNNEL CONSTRUCTION

The expansion joint is equipped with a bored guide for the flange and the construction of the conduit permits the steam pipe to be rotated in their conduits when necessary, thus giving a new surface for the drain back of the condensation.

Running Record of New Buffalo Exhaust Fan

An interesting record for economy in power consumption is reported by the Buffalo Forge Company, Buffalo, N. Y., in connection with three double exhaust fans of the slow-speed, multiblade type. These fans have been in use for some time in the plant of the Cutler Desk Co., having replaced three double fans of another make. Performing the same amount of work, the new Buffalo fans consumed 21 H. P. as against 40 H. P. for the former installation. Figuring power at $35.00 per horsepower per year, this will be seen to effect a saving of $665.00 per year with the three fans, which, applied to the purchase price, was found to exceed a return of 100 per cent. per annum on the investment.

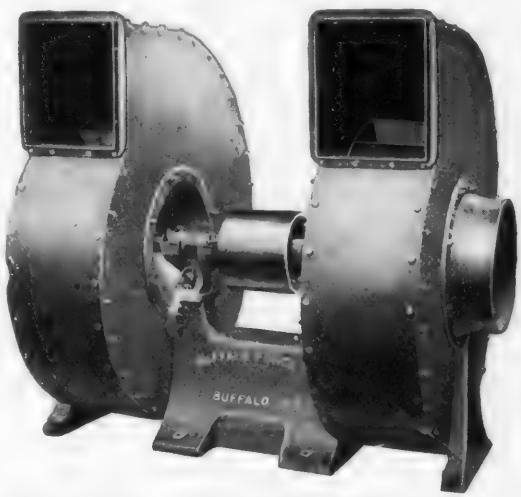
The high efficiency is attributed to the design of the multiblade fan wheel and to its proportions, permitting of maximum efficiency at speeds averaging fully



SLOW SPEED MULTIBLADE BUFFALO EXHAUST FAN OF SINGLE TYPE

30 per cent. below the normal for exhaust fans. The applications of this type of fan are almost as numerous as those of standard design. They are made single or double in sizes from 30 inches to 80 inches in diameter, for pressures from 1 to 6 oz. Like the Buffalo standard exhaust fans, they are made with reversible housings.

Barton Expansion Automatic Steam Trap, made by the Automatic Steam Trap & Specialty Co., Cleveland, O., is a unique device which is illustrated and



SLOW SPEED MULTIBLADE BUFFALO EXHAUST FAN OF DOUBLE TYPE

described in a newly issued circular. The trap consists of an inner and outer tube and is a radical departure from the familiar float and bucket types. The outlet end of the inner tube bears the valve seat. When the steam enters the inner tube it expands and seats itself against the valve disc, thereby sealing the trap. When condensation takes place, the inner tube contracts, allowing the water to escape. The outer tube is also an expansion tube, making the trap useful both for gravity and vacuum heating systems. Pp. 24. Size 6 x 3½ in.

Wanted

Position wanted by heating and ventilating draftsman and estimator. Steam, hot water and fan systems. Eastern city preferred. Also heating supply salesman. At present employed. Address Estimator, care of HEATING AND VENTILATING MAGAZINE.

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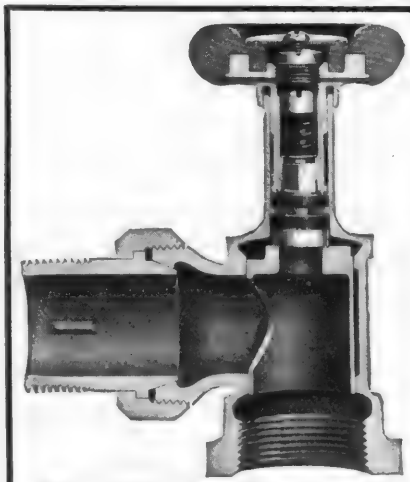

Triton Packless Hot Water Radiator Valve. Made in usual sizes.

The First Packless Hot Water Valve

Wanted for years by every member of the trade. Demanded by architects daily, but never has this demand been met until to-day we are offering you the FIRST PACKLESS HOT WATER VALVE.

The most modern HOT WATER VALVE on the market, requires no packing, cuts down the labor cost, as this VALVE is made and fitted with special care. The materials used are the best that can be secured, it is a quality VALVE from base to handle. Will satisfy owner and architect. Be in the preferred class, get the best heating contracts, use **Triton Packless Hot Water Radiator Valves.**

Interesting literature, interesting prices. Write to-day.

UNITED STATES RADIATOR CORPORATION

GENERAL OFFICES. DETROIT, MICH.

TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes

Grand Rapids, Mich.—Recently the board of education let a contract amounting to $20,000 for the overhauling and installation of a new heating and ventilating system in the principal school buildings. The board now finds that the charter forbids the issuing of bonds, and no money is on hand to carry out the contracts made.

Manufacturers' and Dealers' Protective Association, at its recent annual meeting in New York, elected the following officers for the ensuing year: President, W. M. Seymour; vice-president, J. S. Simmons; second vice-president, G. D. Dorsey; treasurer, L. O. Koven; secretary, F. R. Huntington, 20 Broad street, New York City; assistant secretary, Samuel J. Bailey. Executive committee: W. M. Seymour, J. S. Simmons, G. D. Dorsey, L. O. Koven and P. H. Seward. Trustees: W. M. Seymour, J. S. Simmons, G. D. Dorsey, L. O. Koven, P. H. Seward, A. F. Boardman, F. A. Buckman, Max Goebel, Walter S. Gibbs, Martin Behrer, J. H. Borton, Fred. Lowe and E. E. Haff.

Iron City Heating Co., Pittsburg, Pa., announces that William G. Boyle, formerly consulting engineer for the estate of Henry W. Oliver, will hereafter be associated with its organization. The Iron City Heating Co. was established over nineteen years ago, installing steam and electric power, steam and hot water heating and ventilating systems.

Mexico, Mo., is considering a proposition made by the local electric and water company to put in a central heating plant to supply the business and many portions of the residence sections of the city.

Milwaukee, Wis.—Changes in the heating, decorating and lighting systems of

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Heat and Cold Insulating Materials.

85% Magnesia and Asbestos Air Cell

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CORK COVERINGS FOR BRINE PIPES, Etc.

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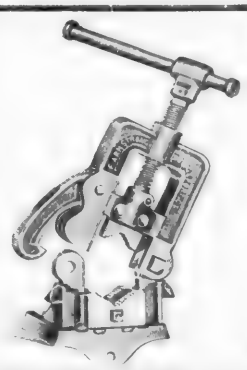
AND CONTRACTS EXECUTED



ARMSTRONG MALLEABLE IRON HINGED VISES.

No. 0	Holds	Pipe	⅛	to 2 ½	in.	11	lbs. each
No. 1	"	"	⅛	" 2 ½	"	16	" "
No. 2	"	"	⅛	" 4 ½	"	30	" "
No. 3	"	"	1	" 6	"	35	" "

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THE ARMSTRONG M'F'G CO.
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NEW YORK BRIDGEPORT, CONN. CHICAGO

the Pabst Theatre are to be made during the summer. H. W. Buemming is the architect.

Jackson, Mich.—A reduction in coal bills from $30,000 a year to $17,510.68 is reported at the State prison at Jackson, as a result of the installation of the new power plant and heating system. The buildings are heated with exhaust steam.

Tacoma, Wash.—Tacoma's city jail in the city hall was reported to be badly in need of proper ventilation as the result of an investigation by a committee of ministers from the Methodist Ministers' Union.

Cleveland, O.—Claiming that the atmosphere in the machine booths of moving-picture theatres is conducive to disease of the lungs, members of a local moving-machine operators' union have appeared before the board of health with recommendations for an ordinance that will provide for the ventilation of these booths, as well as of the theatres themselves. It was stated that during the last two years four operators in Cleveland have died from tuberculosis.

Andrews Heating Co., Chicago, is filling an order for a complete hot-water heating plant to be shipped to Kwangau, Corea, to be used in heating a hospital building at that point.

Quincy (Ill.) Gas, Electric & Heating Co. has formally accepted the thirty-year franchise recently granted to it by the city council of Quincy.

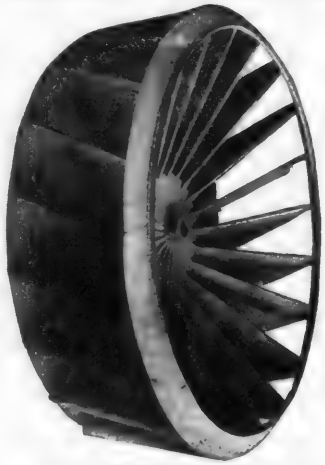
Portsmouth, O.—Claiming that they did not have sufficient ventilation in the department where they were working, seven apprentices and one machinist walked out of the Heer Engine Co., refusing to continue work without better ventilation.

Milwaukee, Wis.—Health Commissioner Kraft has served an order on Supt. Klug of public buildings, directing that the ventilation on the district court be improved. Two suction fans have been ordered placed in the court room and the transoms changed.

Denver, Colo. The consolidation is announced of the Lacombe Electric Co., capital $700,000; Denver Steam Heating Co., $300,000; and the Denver Gas & Electric Co., with $6,056,050 outstanding bonds. The merger is the result of a scheme outlined by Henry L. Dougherty, who controls the companies in question. Patrons of the Denver steam heating system, it is stated will be greatly benefited by the consolidation. A new plant will be built to cost over $750,000 and new mains laid.

Not a Bird Cage, a Squirrel Cage, a Rat Trap or a Skyrocket—but—
A CYCLOIDAL FAN or BLOWER
for all purposes. The Only Radical Improvement in Fans in Forty years
Takes up less room, runs at slower speed, requires less power, noiseless in operation

We guarantee our Cycloidals to equal in capacity any fan built—**We bar none**—with from 20 to 25 per cent. less speed and power. We build them in all sizes to suit all conditions—hundreds of them in use—not "as good—but better."



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Patentees and Sole M'f'rs
1532 McCORMICK BLDG. CHICAGO
Established 1879
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J-M Sectional Conduit

This is a tile conduit, salt-glazed inside and out. Is absolutely watertight.

Acids, gases or the action of the earth do not affect it. Neither can it be injured by weight or movement of pipes. Practically indestructible.

Easily opened after installation. Can even be taken up and relaid. The most efficient conduit for conveying steam, gas, water, brine or other liquids under ground.

Saves 90% of heat lost in transmission through unprotected or poorly insulated pipes.

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Dallas	Minneapolis	Seattle
Detroit	New Orleans	St. Louis

(1348)

Boiler and Radiator Manufacturers elected the following new officers at their recent meeting at the Hotel Astor, New York : President, P. M. Beecher; secretary, William Ritchie.

Washington, D. C.—The appointment is announced of Nelson S. Thompson as chief mechanical and electrical engineer in the office of the supervising architect, Treasury Department. Mr. Thompson succeeds J. E. Powell, who retires on account of ill health. Mr. Thompson is well known to heating and ventilating engineers and has presented a number of papers before the American Society of Heating and Ventilating Engineers, of which he is a member.

Institute of Operating Engineers held a meeting June 17 at its headquarters in the Engineering Societies Building, New York, for the purpose of incorporating. Hubert E. Collins opened the meeting. J. C. Jurgensen was elected to the chair and H. E. Collins was made secretary. The attendance was 85, of whom 58 were members. The meeting was addressed by a number of speakers, following which the roll call was made, and the executive committee signed the incorporation papers, which makes the Institute of Operating Engineers a legal and duly incorporated institute of learning, empowered to issue certificates and diplomas for the various grades. The institute starts with a charter membership of 326. The first annual meeting will be held in New York, Sept. 1, 1911, for the election of officers and transaction of business.

National Association of Master Plumbers, at its twenty-ninth annual convention, held in Galveston, Tex., June 13-16, 1911, elected the following officers for the ensuing year: President, A. C. Eynon, Canton, O.; vice-president, Frank J. Fee, New York; secretary (nominated by the new president), Louis E. Deuble, Canton, O.; treasurer, William McCoach, Philadelphia. The report of the secretary showed a gain in membership of 100, while the treasurer's report showed a balance on hand of $10,700. and the national association was declared to be in healthier shape than ever before. It was voted to hold the next convention in Salt Lake City.

Manufacturers' Notes

Federal-Huber Co., Chicago and New York, announces the withdrawal from the company of A. D. Sanders and A. D. Sanders, Jr., general manager and treasurer, respectively. Their interests in the Federal-Huber Co. have been purchased by Donald A. Raymond, the vice-president. In addition to his other duties, Mr. Raymond assumes the office of treasurer. Mr. Sanders has served as president of the Central Supply Association and of the National Association of Brass Manufacturers, and also as a member of the National Committee of the Confederated Supply Association. The future plans of the Messrs. Sanders have not been announced.

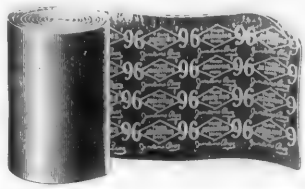
United Electric Co., Canton, O., manufacturers of the Tuec air cleaning devices, has appointed Frederick A. Wilson in charge of its New York branch at 129 Worth street.

Pullman Automatic Ventilator Co., York, Pa., has appointed C. C. Frick in charge of its plant at York. Mr. Frick recently resigned as vice-president of the Security Title and Trust Co., of York. Judge Wanner has handed down an opinion in the equity proceedings of the York Trust Co. against the corporation, dissolving the injunction issued against the concern, June 6, 1910, and commanding W. W. Birnstock, the receiver, to deliver to the defendant all of its property. It is the purpose of the officers of the company to rehabilitate the business.

Abram Cox Stove Co., Philadelphia, Pa., announces the resignation of Charles S. Prizer as first vice-president, effective June 1. Mr. Prizer is succeeded by R. H. Thomas.

United States Radiator Corporation, Detroit, Mich., has leased the ground floor and basement of the northeast corner of Fourteenth and Pine streets, in

JENKINS '96 PACKING



Makes tight and leakless steam joints. And ammonia, oils or acids do not affect it. On permanent work it will last as long as the metals which hold it. For temporary work, when properly applied, it can be used repeatedly. It is strong, tough and flexible.

It is guaranteed.

JENKINS BROS., New York, Boston, Philadelphia, Chicago

St. Louis, Mo., for a term of years. The rooms will be occupied as headquarters and show rooms of the St. Louis branch.

News Firms and Business Changes

Murphy & Lewis, Land Title Building, Philadelphia, Pa., is a new firm composed of E. T. Murphy and A. T. Lewis, which will act as sales managers for the Buffalo Forge Co., Buffalo Steam Pump Co. and the Carrier Air Conditioning Co.

E. F. Singer & Co., 333 Hudson street, New York, has entered the heating and ventilating contracting field.

Bayley Heating Supply Co., Milwaukee, Wis., is the changed name of the Bayley Heating Co.

Aetna Heating and Ventilating Co., formerly of New Britain, Conn., and New York, has located at 422 West 38th street, New York, where in future all of its business will be conducted. The building has been refittted, and considerable new machinery installed in connection with the company's workshop.

York Engineering Co., York, Pa., has been licensed to do business in Virginia, a written power of attorney being filed with the commission appointing W. H. Campbell, of Richmond, statutory agent. The maximum capital authorized by the charter is $50,000, and the objects and purposes the installing of heating and ventilating systems.

Grimshaw & Sturges, 41 Christopher street, New York, is a new firm which will engage in contracting work in connection with the installation of heating, ventilating and power plants. One of the principals is D. E. Grimshaw.

Business Chances

Durant, Okla.—At a special election held in Durant the citizens voted to issue $10,000 bonds to install steam heating systems in four ward school buildings.

Watertown, Minn.—At a special school meeting it was voted to issue bonds to the amount of $3,500 to install a heating plant in the new high school building.

Peoria, Ill.—The Peoria State Hospital has obtained an appropriation for the current year of $943,536.68. Included in the items is $50,000 to begin the work of converting the present hot water heating system into a steam heating system; also $30,000 to begin work of constructing an independent water works for the asylum.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following named work:

Until July 21, 1911, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the United States post office at Alpena, Mich.

Until July 25, 1911, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the United States post office at Schenectady, N. Y.

New Corporations

George J. Gilsdorf Co., Toledo, O., capital $10,000, to conduct a heating and plumbing contracting business. Incorporators: George J. Gilsdorf, William Lower, W. S. Bauserman, Carl J. Lindecker and C. C. Whitmore.

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That's what Dixon's Pipe Joint Compound does and yet permits easy disconnection whenever this is desired.

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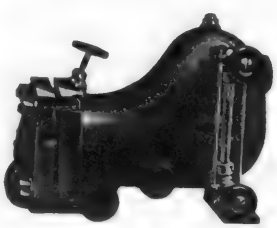

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John Davis Plumbing Co., Elizabeth, N. J., capital $10,000, to engage in heating and plumbing contracting. Incorporators: John Davis, Lucy M. Davis and Harold L. Crane.

Taylor-Flagg Co., Meriden, Conn., capital $35,000, to engage in heating and plumbing business.

Mahony Boiler & Radiator Co., Green Island, N. Y., capital $75,000, to manufacture radiators, boilers and special heaters. The company has recently purchased a plant at Green Island.

General Engineering Co., Fargo, N. D., capital $50,000, to engage in heating, plumbing and electrical work. President, James Kennedy; vice-president, Alex. Stern; secretary and treasurer, W. F. Fortune.

R. H. Lovering Co., Boston, to conduct a heating contracting business. President, R. B. Lovering; treasurer, R. H. Lovering. The foregoing, together with L. V. Walsh, are the incorporators.

Howard-Haley Co., Roanoke, Va., capital $10,000. President, J. E. Howell; vice-president J. M. Haley; secretary and treasurer, G. W. Howell.

Automatic Ventilating Co., Los Angeles, Cal., capital $75,000. Incorporators: L. O. Matthews, J. K. Pennington, M. A. Pennington, N. L. Harden and O. R. Harden.

Boston Heating Co., Buffalo, N. Y., capital $25,000, to engage in heating contracting business. Incorporators: Jason N. Whitcomb, Stuart A. Cummings and George M. Youker, all of Buffalo.

Globe Heating and Engineering Co., St. Louis, Mo. Incorporators: Frank A. Wheeler, Henry A. Dows and T. Warren Jones.

Union Blower & Engineering Co., capital $50,000. Incorporators: R. V. Whiting, F. H. Bryant and L. F. Halloran.

W. E. Keene Co., Cleveland, O., capital $10,000, to manufacture heating and ventilating specialties. Incorporators: C. B. Vinton, W. D. Elliott, William E. Keene, Elizabeth Hatch and Maude E. Keene.

D. & T. Manufacturing Co., 1915 Hamilton avenue, St. Louis, Mo., capital $30,000, to manufacture and market an automatic hot water regulator and circulator. President and manager, J. M. Doherty; secretary and treasurer, H. C. Tatler.

Contracts Awarded

J. C. St. John Plumbing & Heating Co., Colorado Springs, Colo., heating and plumbing new Chaves County court house in New Mexico for $12,000.

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Huffman-Conklin Co., Columbus, O., was the low bidder for the heating and plumbing work for the general hospital buildings in Cincinnati.

H. Kelly & Co., Minneapolis, Minn., power plant and ventilating and heating systems for the Hospital for Inebriates at Willmar. The work will amount to $28,200.

Columbus Heating & Ventilating Co., Columbus, O., hot air heating system in the Washington School building at Wheeling, W. Va., for $7,490.

Thomson & Horner, Winnipeg, Man., heating and ventilating Strathcona school and addition for $16,300. The work will include air washer and vacuum cleaning system; also automatic temperature control system.

Abrahamson & DeGear, San Francisco, Cal., heating and ventilating John Swett grammar school in San Francisco for $8,589.

Garden City Fan Co., Niles, Mich., was finally awarded the contract for the ventilating equipment for the new high school building at that place. Evans & Co., who are the contractors, had let the contract to the B. F. Sturtevant Co., but a storm of protest arose over the fact that the Garden City Fan Co., which is a local industry, was not permitted to do the work. Citizens took up the matter and the Sturtevant Co. finally agreed to relinquish the contract for about $1,200. The money was raised by subscription.

Clift Wise, Springfield, O., new hot-blast heating plant at the Champion division of the International Harvester Co.

Brunka Bros., Marion, Ind., heating the Marion public library for $2,972. Hot water for the heating system will be supplied from the mains of the Marion Light & Heating Co. The building will be equipped with 53,000 sq. ft. of radiation.

J. Wahlman & Son, Ishpeming, Mich., heating plant for Princeton Mine No. 2, of the Cleveland Cliffs Iron Co. The building will be a single story structure of concrete and brick, 32 ft. long and 26 ft. wide.

McMahon Heating & Plumbing Co., Kansas City, Mo., heating and ventilating the building for contagious diseases of the general hospital at Kansas City, for $7,000; the plumbing contract went to Graham & Co., at their bid of $5,300.

Otis Engineering Co., Oswego, N. Y., heating and plumbing Hotel Pontiac for $29,133.

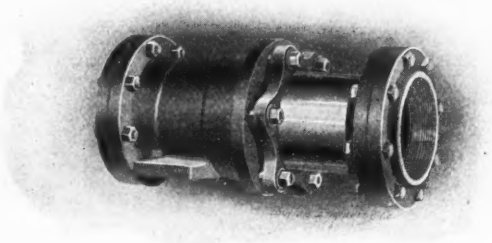
W. D. Mohn Co., Reading, Pa., heating system for Hope Rescue Mission in Reading.

Donnelly & White, Austin, Tex., steam heating Federal building at Dennison, Tex.

Trade Literature

This Is the Only Theatre in St. Louis that Is Fighting the White Plague is the title of a folder describing the cooling and air-purifying effects obtained in the Princess Theatre, St. Louis, which is equipped with the Kinealy system of air purifying and cooling, manufactured and installed by the Kauffman Heating & Engineering Co., of St. Louis. This theatre is supplied with 60,000 cu. ft. of air per minute, or 40 cu. ft. for each occupant, and the air is cooled as much as 20° F. in summer. The company states that this is one of over 300 plants of this type which it has designed and installed.

How New York's Municipal Buildings Are Heated is a folder issued by the H. W. Johns-Manville Co., New York, showing on the cover a group of municipal buildings in City Hall Park, New York, heated from one central plant through J-M sectional conduit. The central plant is located in the Hall of Records and dotted lines indicate the course of the conduit. Other views show details of construction; also a cross section of J-M sectional conduit through supporting tee. A striking series of pictures illustrates typical instances of unsatisfactory installations of other types of conduits.



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Write for Bulletin 104

American District Steam Co.

Lockport, N. Y. Chicago, Ill.

Mueller Reducing and Regulating Valves is a new catalogue embracing the line of reducing and regulating valves made by the H. Mueller Mfg. Co., Decatur, Ill. The company states that it has gone extensively into this business and is making regulators for all kinds of service, including water, steam, air, gas, oil and ammonia. The company is also maintaining a corps of experts on the question of regulating different pressures and is in a position to answer any question or suggest a remedy where intricate problems of pressure exist. The catalogue is well illustrated and the desired information is given in concise form. Pages 20. Size 6¾ in. x 10 in.

Central Station Heating, a handsomely gotten-up publication, issued by the American District Steam Co., Lockport, is a striking testimonial to the growth and success of the central station heating industry. The publication deals in a general way with central station heating and is illustrated throughout with views of private residences, business blocks, public buildings, etc., located in all parts of the United States and Canada which are now being heated by live and exhaust steam from central stations installed by the American District Steam Co. There are also illustrations of the company's methods of construction and other points of mechanical interest. The book is well worthy of a place in every engineer's library. Pp. 56. Size 8 x 10¾ in.

Vacuum Cleaning of Schoolhouses, by Thomas D. Perry, is a reprint, in pamphlet form, of a series of articles that appeared in the *American School Board Journal,* of Milwaukee, Wis. The articles review the methods employed in vacuum cleaning, both with portable and stationary outfits, and include the results of a number of tests with different types of apparatus. One of the articles gives outline specifications for vacuum cleaning equipment. Pp. 44. Size 4½ x 6¼ in.

Kauffman Quality—Kinealy Air Purifying, Cooling and Humidifying System is the title of a well-designed and exhaustive catalogue lately published by the Kauffman Heating & Engineering Co., St. Louis, Mo. The catalogue is intended for the use of architects, engineers, contractors and the general public who are interested in the subject of air purifying and air conditioning. The company's engineering staff includes Prof. J. H. Kinealy, the inventor of the system and apparatus. Full details are given regarding the high grade of materials used in the Kinealy air purifier, together with detailed directions for its installation and operation. A special section is devoted to data for the Kinealy air washer, Types A and B, while a number of pages are devoted to engineering data in connec-

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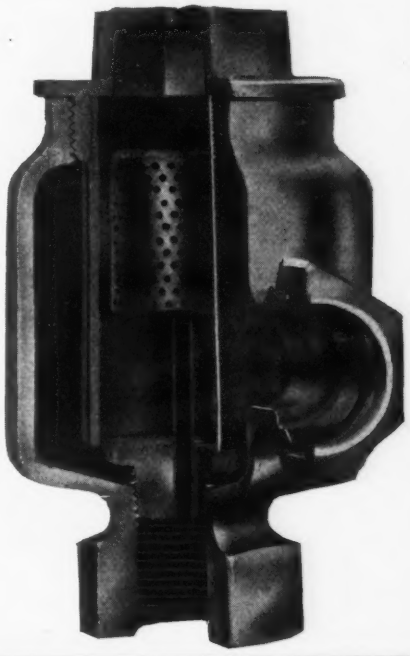

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tion with humidity work. Numerous illustrations of the apparatus serve to bring out clearly the various points mentioned in the descriptive matter. Views of buildings equipped wtih the Kinealy apparatus, in several cases accompanied by striking testimonials, are a notable indication of the efficiency of the apparatus, as indicated by its wide use. Pp. 55. Size 8 x 8½ in.

Royal Smokeless Boilers, made by the Hart & Crouse Co., Utica, N. Y., is the title of an interesting publication devoted to the type of heater, which is equipped with a down-draft grate. The point is made that this boiler will burn soft coal of any grade without showing smoke. The boiler is of water tube construction, having two fires. Raw fuel is thrown on the upper grate, through which water circulates. The fire burns downward, so that all smoke and gases must pass downward through the body of fire, with the result that opportunity is given them to become fully ignited and thus perfect combustion secured. Many buildings are shown which have been equipped with this type of boiler. Pp. 48. Size 8 x 8 in.

BOOKS ON HEATING AND VENTILATION

Heating and Ventilating Buildings, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Fifth edition, largely rewritten. 577 pages. 277 Ills., 8vo, cloth. $4.00.

Baldwin on Heating; or Steam Heating for Buildings By William J. Baldwin. Fifteenth edition. Revised and enlarged. 391 pages 131 figures. Size, 5x7½ in. Contains descriptions of steam heating apparatus tor warming and ventilating large buildings and private houses, with remarks and tables. Cloth, $2.50.

Handbook for Heating and Ventilating Engineers. By Prof. James D. Hoffman and Benjamin F. Raber. The latest book on this subject. Unusually comprehensive. 320 pages, with 45-page appendix. Size 4½x6¾ in., bound in flexible leather. Price, $3.50.

Questions and Answers on the Practice and Theory of Steam and Hot-Water Heating. By R. M. Starbuck. Illustrated. $1.00.

Ventilation of Buildings. By William G. Snow and Thomas Nolan. 83 pages. Pocket size. Contains a statement of the general principles of ventilation and of their application to different kinds of buildings. Boards, 50c.

Steam Heating and Ventilation. By Wm. S. Monroe. Containing formulas and data valuable in the designing of heating and ventilating plants. Price, $2.00.

Air-Conditioning. By G. B. Wilson. Being a short treatise on the humidification, ventilation, cooling and the hygiene of textile factories—especially with relation to those in the U. S. A. With figures. 12mo. Illustrated. 143 pages. Price, $1.20.

Steam-Electric Power Plants. By Frank Koester. A practical treatise on the design of Central Light and Power Stations and their economical construction and operation. 473 pages. 340 ills. Price, $5.00.

Light, Heat and Power in Buildings. By Alton D. Adams, M. E. The purpose of this volume is to present in compact form the main facts on which selection of the sources of light, heat and power in buildings should be based. The problem is to determine the kind of equipment that will yield the service required at the least cost. 12mo. Cloth, $1.00.

Practical Steam and Hot Water Heating. By Alfred G. King. Containing over 300 detailed illustrations. The book is a working manual for heating contractors, journeymen steam fitters, architects and builders. Describes various systems of heating and ventilation and includes useful data and tables for estimating, installing and testing such systems. 8vo. 367 pages. Price, $3.00.

Dean's System of Greenhouse Heating, by steam of hot water, with formulas for obtaining different temperatures, by Mark Dean. Price, $2.00.

Power, Heating and Ventilation. By Charles L. Hubbard, B.S., M.E. A treatise for designing and constructing engineers and architects. The whole subject of heating is covered, including the heating of large institutions with central plants. Space is also devoted to electrical matters connected with steam plants. 647 pages. Price, $5.00 (three volumes in one).

Notes on Heating and Ventilation. By John R. Allen. 152 Pages. 34 illustrations. Size, 4½x6½ in. One of the new books, brought quite up to date, and containing much information to guide the intelligent steam fitter in the installation and heating and ventilating apparatus. Cloth, $2.00.

Hot-Water Heating and Fitting. By W. J. Baldwin Fourth edition. Price, $4.00.

Steam Fitters' Computation and Price Book, abridged. By Mark Dean. Price, $2.50.

Practical Treatise Upon Steam Heating. By F. Dye. Embracing methods and appliances for warming buildings, etc. Lowpressure, high pressure and exhaust steam. 8vo, cloth, illustrated. Price, $4.00.

The School House. Its Heating and Ventilation. By J. A. Moore. 204 pages, illustrated. $2.00.

A Manual of Heating and Ventilation, for engineers and architects, embracing tables and formulas for dimensions of pipes for steam and hot-water boilers, flues, etc. By F. Schumann. Second edition, revised and enlarged. 12mo, $1.50.

German Formulas and Tables for Heating and Ventilating Work, especially adapted for those who plan or erect heating apparatus. By Prof. J. H. Kinealy. Illustrated. Price, $1.00.

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